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The Mount Morgan Mine

By Frank Conly*

Mount Morgan, in central Queensland, is the largest gold mine in Australia, and perhaps, in its way, the most wonderful in the world. The greater portion of the property was taken up in two selections of 640 acres each by Donald Gordon, a cattleman, to protect himself against settlers. One of these selections included most of a small mountain, dotted over with boulders of a dark metallic appearance. Gordon was forced by a drought to abandon his run and go to Mount Wheeler where he got a job in the Galawa mine.

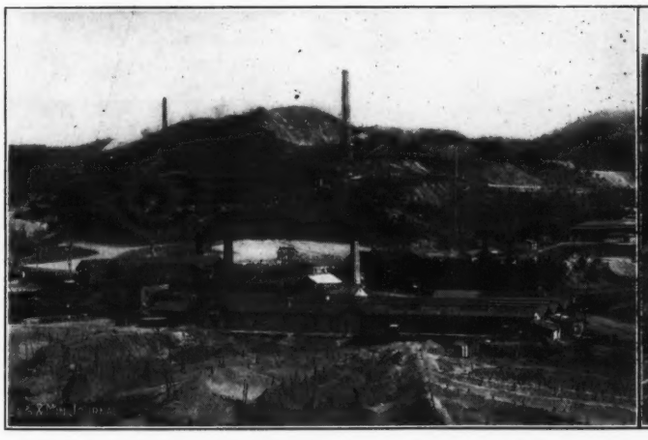
He had not been mining long before it struck him that the boulders of Mount Wheeler somewhat resembled those of the mountain of his abandoned run. He offered to show the spot to Frederick Morgan, manager of the mine, and as the result of a visit the property changed hands for $5 per acre.

It did not take Morgan long to find gold ore near the summit of the mountain, which assayed 37 oz. per ton. He thought, however, that he had discovered a small, rich deposit, whereas the property has proved to be a great mass of medium ore.

A copartnership was formed with his two brothers, two sons of one of these and T. S. Hall, W. K. D'Arcy and William Pattison. These last three finally bought out the Morgan holdings and in 1886 formed a limited-liability company with a capital of $5,000,000, in shares of $5 each. Lack of capital, probably, led to these successive sacrifices of valuable holdings.

Soon after the company's formation, the shares rose to a premium and many attempts were made to jump the company's claims. A series of legal fights resulted that lasted for years. The jumpers formed a company of their own and issued scrip, which actually was bought and sold in the open market like other mining stock and at one period fetched a substantial figure. Eventually, however, the Mount Morgan Co. won all the suits.

The comparative isolation of so large a body of gold ore has provoked much discussion as to its origin, and this is commonly attributed to a thermal spring. The present holding of the company is 730 acres, made up of Donald Gordon's original freehold of 640 acres, certain leaseholds and a consolidated claim embracing 30 men's ground. The value of the minerals taken out from the date of formation of the company up to April, 1912, was between $80,000,000 and $90,000,000; and the mine has many years of life before it. In 1911, there were 3060 men employed, drawing in wages over $2,000,000 and including those engaged on the branch railway specially constructed to serve the mine and those getting lumber and coal for the furnaces, there were in all about 25,000 people depending on Mount Morgan for their livelihood.



Mount Morgan Opencut

General View, Mount Morgan

Much of the ore is now got out by underground methods, the lowest level, so far, being at 900 ft., but the most interesting spectacle is the huge opencut, reminding one of a stone quarry, or the crater of a volcano. The top of the mountain is gone, and the lowest level of the opencut is 350 ft. below where the top used to be, while the upper edges of the cut are from 800 to 900 ft. apart.

There are two separate classes of ore, one bearing gold only, and the other carrying copper, silver and gold. From the straight gold ore, the metal is extracted in an economical chlorination plant, while the copper-gold ore is crushed and then smelted, the blister copper obtained being sent to Sydney, where the gold and silver are

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separated by electrolytic methods. These uptodate processes are in marked contrast to those employed in the early days, evidenced by the fact that $5,000,000 was extracted from the retreated tailings of early processes.

Head of the Mining Department, Panama Pacific Exposition

Prof. Charles E. Van Barneveld, head of the College of Mines of the University of Minnesota, has been appointed director of the department of mines and metallurgy of the Panama-Pacific exposition, which will be held in San Francisco in 1915, and has entered upon his new duties. He has had an extensive experience in practical mining work in the United States, Mexico and Canada, and has been associated with the Minnesota College of Mines for the last 14 years.

CHARLES E. VAN BARNEVELD

Professor Van Barneveld is a native of Holland and a graduate of McGill University, Montreal, Canada. He is author of "Iron Mining in Minnesota," and of other works on mining which have won recognition as standard references, and is acknowledged as one of the foremost authorities of the country in his field of science. "I shall need the coöperation of the mining men of the whole world to assist in getting together at the Panama-Pacific exposition a live exhibit which will be worthy of the great mining industry," said Professor Van Barneveld. "We have the means and the material for building up a wonderful display, exemplifying all phases of the mining industry's latest developments."

The Palace of Mines and Metallurgy will be one of the handsomest of the 14 exhibit palaces now being erected at Harbor View, the exposition site. The extent to which the subject is to be featured at the Panama-Pacific international exposition is indicated by the classification of exhibits in this department, just announced by Capt. Asher Carter Baker, director of exhibits. There will be five groups: (1) Working of mines, ore beds and stone quarries; (2) minerals and stones and their utilization; (3) mine models, maps and photographs; (4) metallurgy; (5) literature of mining and metallurgy. These groups are subdivided into 58 classes, which will include displays relative to equipment and methods of geological surveys, mining bureaus and other societies for the promotion of mining; prospecting for mineral veins and deposits, petroleum, gas and artesian waters; assaying and sampling; drilling and breaking down rock, sinking shafts, and opening galleries, drifts and tunnels; explosives and their use in mining; the mining of coal and other minerals; the use of motors in mine operation; underground handling and transportation of ore; machinery and appliances for drainage; methods of ventilation; methods of lighting; mine safety, including signals, telephones, preventives of explosions and other accidents; rescue work; handling and weighing mine products above ground. These are but a few of the classes in the first group; the other groups are subdivided just as comprehensively. The exhibit in its entirety will not only afford exceptional educational opportunities to the public in general, but will be of particular value to mining men in the special fields of their activity.

Grade of Lake Superior Ores

A series of tables compiled by W. L. Tinker, secretary of the Lake Superior Iron Ore Association, shows the iron contents of ores from the different ranges over a series of years. From these we present the following tables, showing the natural iron as ascertained in 1902, 1906, 1911 and 1912, and the phosphorus contents in the case of bessemer ores.

Ranges	1902	1906	1911	1912
Marquette:				
Bessemer, iron	58.2631	56.5151	54.0668	54.4180
Bessemer, phosphorus	0.0424	0.0485	0.0375	0.0403
Nonbessemer, iron	55.1032	53.9861	52.4757	52.7308
Menominee:				
Bessemer, iron	57.7141	55.8979	54.5578	55.2117
Bessemer, phosphorus	0.0167	0.0363	0.0330	0.0252
Nonbessemer, iron	54.1020	52.2508	51.4315	51.0527
Gogebic:				
Bessemer, iron	55.7324	54.2732	54.5312	54.2386
Bessemer, phosphorus	0.0418	0.0416	0.0400	0.0410
Nonbessemer, iron	53.7872	51.8580	52.9294	53.2912
Vermillion:				
Bessemer, iron	61.5522	60.1254	59.5940	59.3095
Bessemer, phosphorus	0.0398	0.0393	0.0384	0.0385
Nonbessemer, iron	61.9984	64.5798	59.5984	58.7775
Mesabi:				
Bessemer, iron	56.6690	54.6196	52.9224	53.2573
Bessemer, phosphorus	0.0395	0.0441	0.0462	0.0469
Nonbessemer, iron	53.5531	50.8088	50.4934	49.4922

The main point to be noticed in these tables is that the decline in iron contents of the ores, which has been progressive for several years, was apparently arrested in 1912. For nearly all the ranges there was a slight increase over 1911, or at least no decrease.

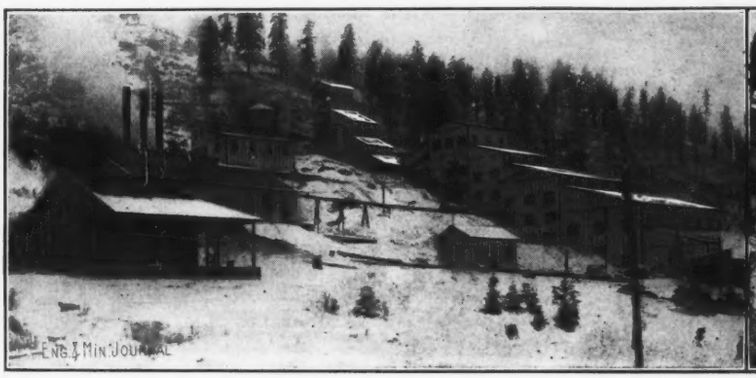
Another notable point is the decrease in the proportion of bessemer ores to the total, which has taken place in the last 10 years. On the Marquette range, the decline in the proportion of bessemer ores was 29.9% in 1902 to 15% in 1912; on the Menominee from 2.8 to 2.5%; on the Gogebic from 87.5 to 64.1%; on the Vermillion from 80.1 to 74.9%; on the Mesabi from 80.6 to 45.3%. The Vermillion range has always shown the highest percentage of bessemer ores.

Cyaniding the Ores of Republic, Wash.

By Herbert A. Megraw

SYNOPSIS—An instance of successful treatment of ores which had been considered exceptionally refractory and had resisted former attempts to treat them. Previous failures due to an incomplete understanding of the nature of the ore and its requirements. The rock is exceedingly hard and contains gold in minute particles disseminated through it. The vital requirement is fine grinding to expose these fine mineral particles to the action of cyanide solutions. The mill of the North Washington Power & Reduction Co. uses rolls, chilean mill and tube for grinding, reducing everything to condition of slime. Agitation in cyanide solution by established practice and precipitation by the use of zinc dust. The San Poil mill is treating ore in much the same way, a unique feature being the use of a hammer trommel mill for breaking ore at one operation from mine run to $\frac{3}{16}$ in. Extractions of over 90% are being obtained on both gold and silver. Oliver filters are used.

The mining camp of Republic is situated in the northwest section of Ferry County, Wash., about 25 miles south of the Canadian line. In common with most mining camps it has been the scene of intermittent activity and decline, and has had a hard time to demonstrate its value. The district, originally a part of the Colville Indian reservation, was opened in 1896 and its history since that time has been a checkered one of alternating interest and indifference. Lately, however, its mines have begun to be developed in a methodical manner which, if slow, is at least more satisfactory and certain than can be obtained by a succession of booms.



North Washington Power & Reduction Co.'s Mill

San Poil Consolidated Mill, Republic, Wash.

Many Unsuccessful Mills Built

Republic has seen a series of mills built within her boundaries, none of which seems to have made any remarkable success. The first one was built for the Republic Gold Mining & Milling Co., and made use of the Pelatan-Clerici process. Naturally, this was not much of a success, the saving amounting to perhaps 50% of the contained silver and gold. Then followed a series of plants embodying the chlorination process, combined amalgamation and cyanide, the Hendryx cyanide system, and finally the plant constructed by D. C. Jackling for the Republic Power & Cyanide Co., built in 1900. This plant operated for about 10 months and was then shut down. It was patterned after the old Mercur plant in Utah, and included crushing by means of rolls and Griffin mills, roasting and leaching. Precipitation was attempted by the old method of using zinc dust in tanks, as was done at Mercur. This mill is reported to have saved about 91% of the gold in the ore but only about 15% of the silver.

Due to the many methods of treatment and the apparent failure of all of them to accomplish any commercially successful results, the camp received a bad name and the ores, while the quantity and grade were acknowledged, were thought impossible to treat by any means sufficiently cheap to insure profit. As a matter of fact, the trouble appears to have been the persistent attempts to fit a process which had proved useful somewhere else to the ores at hand, which happened to be not in the least appropriate for it.

There seems to have been a remarkable lot of misinformation published about the character of the ores. Some experimenters went to a great deal of trouble to prove that they were not treatable cheaply, and apparently satisfied themselves and a large portion of the mining public. That the mineral itself does not justify this conclusion, the two plants now in operation prove.

Some Ore Extremely Hard

The ore is described as being a fine grained, close textured quartz, but there is also some white quartz which is not so hard and which is easily distinguished from the blue, flinty, hard material mentioned. Ore from some portions of the camp is more like a clay and contains an extremely large amount of colloid matter. It will be seen that there is a great variety of ore, but that at present worked by the mills consists largely of the blue quartz and white quartz, and is, in general, hard.

Note—This is the fourteenth of a series of articles by Mr. Megraw on American cyanide practice. Previous articles appeared Nov. 2, Nov. 23, Dec. 14, Dec. 21, Dec. 28, 1912; Jan. 4, Feb. 8, Feb. 15, Feb. 22, Mar. 1, Mar. 8, Mar. 29 and Apr. 5, 1913. The next article will deal with "Cyaniding at Grass Valley, Calif.," and will appear on May 17, 1913.

While it has been repeatedly stated that this ore contains elements which make it rebellious to cyanide treatment, such as tellurium, selenium and copper, repeated tests have failed to detect tellurium, selenium exists only in minute traces in ores of milling grade, and copper only in small quantities. Neither of these last two elements presents any insuperable obstacle to cyanidation as selenium compounds are usually soluble and exist in quantities too small to consume excessive amounts of cyanide, and the same is true of copper, which occurs in somewhat larger quantities.

It is undoubtedly true that the ores did not prove amenable to the processes applied to them, but as has been stated, these methods were not adapted to the ores. Later methods and careful experimentation has, however, opened up an entirely new viewpoint.

In discussing the matter, H. W. Newton, superintendent of the mill of the North Washington Power & Reduction Co., at Republic, who is familiar with the ores, having studied them and experimented on them for years, and who is responsible for their present successful treatment, stated that he had made a number of experiments on roasted samples and invariably found that while a slight increase of gold extraction was obtained on subsequent cyanidation, invariably the extraction of silver decreased and almost disappeared. This was undoubtedly one of the reasons why the mill built by Jackling was not successful as the silver is in quantities too great to be ignored and constitutes a large proportion of the value.

Another point which has been detected and pointed out by Mr. Newton is that the gold occurs in such fine particles as to be rarely visible, is scattered through an extremely close-grained rock so that the finest grinding is necessary to liberate it and expose it to the action of cyanide solutions.

The silver probably occurs as a sulphide, or sub-sulphide, and is soluble readily enough in stronger cyanide solutions, though when roasted it is converted into some other form, probably metallic silver, which is not readily soluble in cyanide solutions. The reasonable treatment, then, would appear to be sliming of the total ore and agitation in cyanide solutions without roasting or any other auxiliary treatment. And this has proved to be the case.

A Roll Crushing Mill

The mill of the North Washington Power & Reduction Co. was commenced in 1911 and has now been in operation something more than seven months. It handles ore from the Surprise and Lone Pine mines, a rather hard run of ore. Railroad cars deliver the ore to the mill where it passes through a system of crushing and sampling as shown by the accompanying flow sheet.

From the first bin, the ore passes over a grizzly to a Blake crusher and then over another grizzly to a set of 16x22-in. rolls. From this set of rolls it is passed through a wire-screen trommel, the apertures of which are $\frac{1}{8}$x$\frac{1}{2}$ in. The oversize is taken to a set of 14x30-in. rolls, after passing which it joins the undersize from the trommel and passes through the sampling plant to the mill bin.

Grinding in Chilean Mill

From the mill bin the ore, now reduced to such size that the largest pieces are about $\frac{3}{16}$ in., is passed to a chilean mill, where it is crushed to pass a 16-mesh screen, then through a 45-in. Akins classifier and the sand to a tube mill, 5x22 ft., where it is slimed.

There is some difficulty with this crushing system, the crucial point being in the chilean mill. The capacity of the plant is about 100 tons per day of 24 hr., and yet there is extreme difficulty in getting the chilean mill to crush the amount of coarse material contained in the feed, which is not large, through the 16-mesh screen. This condition should not exist, for the material is all small, as has been mentioned, and the screen is coarse. The difficulty probably depends on two factors, one of which is the fineness of the feed. A feed of this fineness is usually considered too small to give maximum efficiency with a chilean mill, although at some plants large capacities are obtained with similar material. This is exemplified at the Portland and Independence mills at Cripple Creek. Too fine feed in a chilean mill usually results in building a bed on the die ring, the rollers riding over it without doing much grinding, and the operators at the North Washington mill state that this is what occurs in this case, but they also state that increasing the size of the material decreases the capacity, and conversely, though with a very fine feed there is not much left for the mill to do but pulp the material and put it through the screen.

The probability is that there is something wrong with the design of this chilean mill and that it is not adapted to ores of this kind. I feel convinced that under normal conditions there would be no difficulty in handling a sufficient tonnage of this material. It is reduced with greatest ease in the rolls.

Tandem Tube Mills

At present there is one tube mill in operation, as has been mentioned, but serious consideration is being given to the installation of a second one, and the replacement of the chilean mill with a short tube mill of large diameter, having ribbed lining of the Komata type. This would probably be an advantageous change and by it the capacity of the mill could be materially increased. A short mill of large diameter equipped with the ribbed lining would efficiently break up the coarser portion of this mill-run of ore and leave a product sufficiently varied to be efficiently slimed in the succeeding two fine-grinding mills.

Trent Agitators Used Satisfactorily

Closed circuit between the classifier and tube mill is effected and the slime which leaves the classifier is taken to the first of a series of four agitation tanks, 33x20 ft., which are equipped with the Trent agitator.

The operators claim that every satisfaction is obtained from the use of these agitators even in the large, deep tanks installed. They perform their work with a minimum of trouble and give good results in extraction. The aëration of the pulp is said to be good and extraction proceeds satisfactorily.

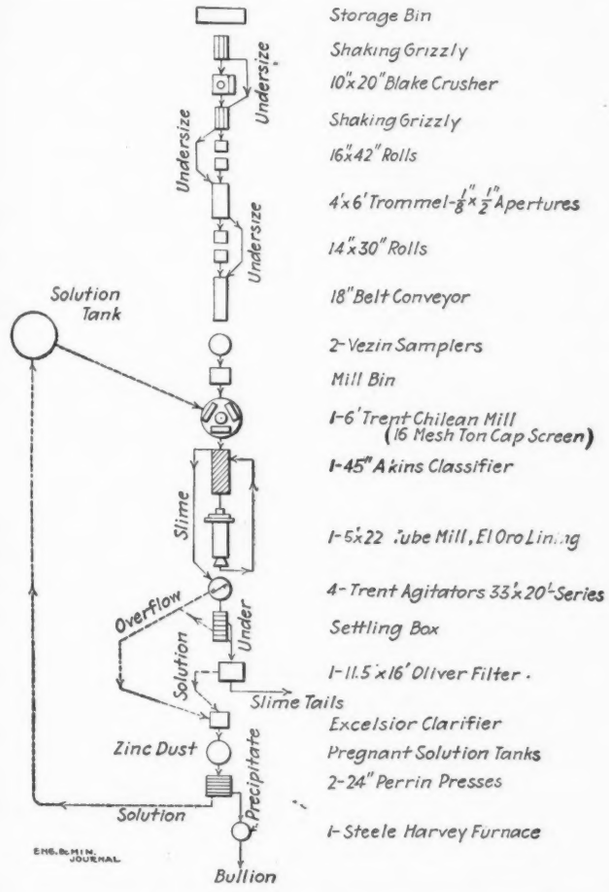
The first tank is used as a thickener as well as agitator, the overflow going to the precipitation department. Agitation is continuous through the series of tanks, the passage through them being accomplished in about 36 to 40 hours.

It will be noted that the agitation capacity of these tanks is sufficient for a good deal more tonnage than can

be delivered by the crushing and grinding department. The slight changes necessary for increase of that part of the mill would be well worth making.

Strong Cyanide for Silver Extraction

The strength of the cyanide solution in these agitation tanks is kept at about 5 lb. KCN per ton of solution. While a solution containing 2 lb. per ton would be ample for the extraction of the gold, in less time also, the strength is kept up to 5 lb. in order to make the best possible extraction of silver. The lime is added to the first of the series of agitation tanks at which point also the solution is standardized in cyanide content.



Flowsheet of the North Washington Power & Reduction Co.'s Mill, Republic, Wash.

Lead acetate is used intermittently. It has been found that after several days' use of the acetate it can be discontinued for a long time, the relation being approximately, using it for one week and omitting it for three weeks. If it is discontinued for much more than this time, trouble develops which is believed to be due to soluble sulphides, the condition being immediately remedied by the addition of the lead salt.

From the agitation system the pulp is either taken directly to the Oliver filter or is first passed through a settling box for thickening it. The procedure is usually to omit the settling box as the pulp is already in good condition for filtering.

The Oliver filter is a large one, 11.5x16 ft., and is said to be doing excellent work.

Zinc-Dust Precipitation

Zinc dust is used for precipitation, this being the most acceptable method when treating ores containing copper, as the metal is recovered immediately from the solution and does not tend to make useless a large amount of zinc, as is the case when shavings are used. The Bosqui system of agitating zinc dust in tanks with the pregnant solution and then pumping the mixture through a filter press, is followed.

There is not a large amount of copper present, but what little there is may be removed in this way from solution. A statement of the comparative content of the ores milled is given as follows: From the Surprise mine, gold, 0.51 oz.; silver, 5.80 oz.; copper, 0.2%, and from the Lone Pine mine, gold, 0.32 oz.; silver, 2.20 oz.; copper, 0.1%. It will be seen from this statement that the copper is not in sufficient quantity to cause any great difficulty.

The average grade of ore treated at the mill for six months has been $9.55, and the extraction of gold during this time was 92.8% and of silver 90.5%. The consumption of cyanide is 1.3 lb. per ton of ore treated, of lime, 4.5 lb., and of Zn., 0.6 lb.

The mill consumes 2 hp. for each ton of ore milled and employs 12 men in its actual operation in addition to six men at the power plant. Power is electric, generated by a not very efficient steam plant at the mill, and is expensive. It is expected that hydro-electric power will be available within the near future when, based on the expenses at the present time, the total cost of treating the ore will not exceed $2 per ton.

Extraction percentages are based on the samples taken at the head of the mill by the sampling plant and calculated against the tailing samples taken below the filter. It is said that the bullion return checks closely with these calculated results.

The precipitate is not acid treated, but is melted with flux in a Steele-Harvey furnace. The refinery department is situated at the head of the mill and in a separate building.

A New Crushing Machine

The mill of the San Poil Consolidated Co., the only other plant operating at the present time in the Republic district, is situated in a cañon some little distance north of the town. The mill has been recently completed and is operating on ores of much the same character as those referred to in connection with the North Washington mill, hard, close-grained quartz.

Railroad cars deliver the ore into the bin at the head of the plant and from this bin an 18-in. belt conveyor delivers it to a Williams hammer trommel mill. This machine is unusual in milling plants. It is constructed much like the Quenner dry placer machine which was devised at the Altar field in Sonora, Mexico. It consists of a trommel built of heavy bars spaced $\frac{3}{16}$ in. apart, revolving at 100 r.p.m., and a central shaft running through it revolving at 600 r.p.m. Upon the central shaft are 32 hammers weighing 16 lb. each connected with the shaft by heavy chains. The hammers swing so that there is no danger of their touching the trommel. Ore is introduced at one end of the machine and the hammers, flying out by centrifugal force, strike the pieces of rock and shatter them. Several kinds of metal have been used in making these hammers, which receive the major

part of the wear, and at present the most available material has proved to be mild steel, sawn from the bar, and drilled to receive the chain connections. Wear of the hammers has diminished from an original two or more pound per ton of rock crushed to a point where it is not much more than 0.5 lb. per ton.

The machine certainly does an immense amount of work, reducing mine run to a granular product at one operation. The product is supposed to come out through the trommel bars at $\frac{3}{16}$ in., the distance between the bars, but there is a good deal of it which is considerably larger, presumably due to wearing of the bars, thus enlarging the openings. In operation the machine makes an enormous amount of dust as the dry ore is broken up. When damp ore is used the quantity of dust is not so great and the general product is finer, but its capacity is much reduced. Sizing tests on the product show as high as 40% of the product passing a 20-mesh screen, of which 65% is finer than 10-mesh and 6% through 200-mesh screen. About 70 tons per day are being milled through the machine. Its capacity is 10 tons per hour.

It is acknowledged that this machine is still in the experimental stage, although the operators believe it will continue to perform its work as at present. The machine now installed is to be exchanged for another similar one built much heavier, but designed to do the same work in the same way. It will, however, require incontestable proof to show that a machine of this kind can be built strong enough to stand the enormous strain of reducing mine-run ore to ¼ in. or even ½ in. at one operation by such strenuous means and be economical,

Sampling the fine ore is done automatically, and after passing the rolls, as shown in the accompanying flow sheet, it is sent to a 5x22-ft. tube mill which is in closed circuit with a duplex Dorr classifier.

Air Agitation Tanks Used

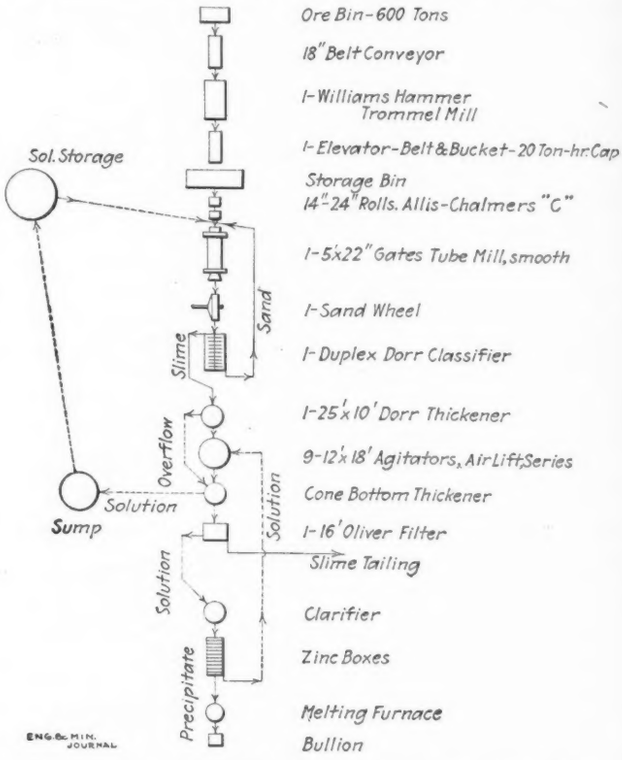
The slime from the classifier is thickened in a Dorr thickener 25x10 ft., and the thickened pulp taken to a series of nine agitator tanks, each 12x18 ft., with cone bottoms and using air agitation. In addition to the central air lift in these agitators, which are cut off below the surface as is done in the tanks at Grass Valley, to be mentioned in the following paper, there are three additional lifts in each tank, designed to avoid settling of slime on the cone bottoms which are too flat to do this automatically. Treatment through the tanks is continuous and solution from 5 to 7 lb. KCN per ton is used. At this mill the stronger solutions are used in the tube mill, the weaker ones being made up at the agitators. The time of agitation is 50 to 70 hr. in the tanks.

From the final agitator of the series the pulp is taken to a cone-bottom thickener and thence to an Oliver filter, 16-ft. drum, where filtration is effected. The pregnant solution is passed through zinc boxes using shavings and the barren solution issuing is passed back to the final agitator of the series of nine, thus diluting the pulp and giving it a wash before going to the thickening box and filter. Solution overflowing from the thickener is pumped back to storage to be used over again.

The ore averages $8 per ton in value and 92 to 95% is extracted. Consumption of KCN is 1.5 lb. per ton and CaO 2.3 lb. per ton.

There is nothing particularly novel about this plant with the exception of the Williams mill above mentioned, but it is another link in the chain of recent events which have shown clearly that the ores of the Republic do not deserve the reputation they have received for being difficult to treat and that when use is made of the means which have been developed within the last few years for the better working of the cyanide process, together with the essential and vital point of the metallurgy as applied to this particular rock, extremely fine grinding, there is no difficulty in beneficiating it cheaply and efficiently.

Neither of the mills at present in operation is perfect nor to be taken as a model of its kind, but considering the difficulties in the way of getting sufficient capital to



Flowsheet of the San Poil Consolidated Mill, Republic, Wash.

treat ores which had already been tagged as hopeless, they are good, and too much credit can not be given to the men who have made a metallurgical success where inevitable failure was freely foretold.

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Hungarian Mineral Production for 1911

The mineral output of Hungary for 1911, is given in the official reports as follows, *Oest. Zeit. f. B. u. H.*, Mar. 15, 1913, the items standing in order of decreasing values: Lignite, 7,997,451 metric tons; pig iron, 518,450; rock salt, 240,318; coal, 1,023,129 metric tons; gold 3194 kg.; coke and briquettes, 263,516 metric tons; iron ore for export, 668,438; pyrites, 96,754 metric tons; silver, 10,505 kg.; bitumen, 3861 metric tons; copper, cement and ore, 2174; lead and litharge, 1583; antimony, crude and refined, 891; mercury, 79; copper, 207; manganese ore, 14,755; petroleum, 2190; silver ore, 20; antimony ore, 80; zinc ore, 106; sulphur, 51; alum stone, 600; cobalt and nickel ore, 2 metric tons.

Tennessee Copper Company

The report of the Tennessee Copper Co. shows that the total net profit from its operations at Copperhill, Tenn., for the year ended Dec. 31, 1912, after making a reserve of $100,000 for depreciation of the plant, was $1,095,875. In addition to the $100,000 written off for depreciation the company reserved an additional $50,000, and has also placed in the surplus reserve account $150,000 from the net profits of the year. Two dividends aggregating $500,000 were paid.

Development work to the extent of 2717 ft. was done in 1912, divided as follows: Raises and winzes, 655 ft.; shafts, 33 ft.; drift and crosscutting, 833 ft.; diamond drilling 1196 ft. The total ore reserves are estimated at 5,071,000 tons, of which 3,691,000 tons are available.

The Polk County mine was shut down from July 15 until Oct. 14, during which time the entire surface plant was rebuilt and the shaft remodeled to accommodate a self-dumping guide skip. The Burra Burra mine was shut down from May 18 to May 29, during which time the skip road and timber structure from the collar of the shaft to the top of the headframe were practically rebuilt. The physical condition of this mine is stated to be good. The method of back stoping is meeting expectations. Over 60% of the year's tonnage came from back stopes and at the end of the year there were broken in these stopes over 65,000 tons of ore. In the London mine back stoping was started on the third level north on timber drift. A large part of the floors of the first and second levels north will thus be recovered and the ore trammed through the third level timbered drifts. As the shaft is now down to the sixth level some new stopes will be opened up during 1913. No work was done at the Eureka mine during 1912.

A 25-year lease on an extensive orebody known as the School property was taken during 1912. Diamond drilling was started in December and will be prosecuted during 1913 for the purpose of determining in a preliminary way the grade and extent of this deposit.

The water supply for all mines was materially improved by the construction of a large reservoir at the McPherson shaft, which obviated the necessity of pumping muddy water after rains.

The smelting plant treated 444,289 tons of company ore yielding 13,252,634 lb. of copper, which shows an average of 29.8 lb. of copper per ton of ore. In addition, 36,980 tons of custom ore, yielding 4,427,583 lb. of copper, equaling 119.7 lb. of copper per ton, were treated.

During the year the old converter was changed from acid to basic lining. The hoods were renewed and an efficient flue system installed. For drying the siliceous material a Ruggles-Coles dryer was installed. Converting is now being done more cheaply than ever before.

The old sintering plant was completely rebuilt and enlarged, and two 42x264-in. Dwight & Lloyd machines installed. This plant was running at a fair capacity the last few months of the year. Provision was made for a new slag dump back of the acid plant.

The total production of acid for the year was 192,084 tons of 60° Bé. Another Gay-Lussac tower, a duplicate of Nos. 9 and 10, was started the latter part of the year. Nos. 9 and 10 Gay-Lussac towers were put in operation the latter part of 1911 and have proved satisfactory. From May 18 to June 2, both acid plant and smelting plant were closed down for the necessary annual overhauling and repairing. These repairs put the entire acid plant and connections in excellent condition.

The total cost was $2.88 per ton of ore, which is equal to 9.65c. per lb. of fine copper. This is a reduction of 15c. per ton from the 1911 figure. Had the extraction of copper per ton of ore been the same as the previous year, 31.6 lb. instead of 29.8, the cost per pound of copper at Copperhill would have been but 9.1c. Mr. Wierum states that the reason for the lower extraction was that for a large part of the year the sintering plant with which the flue dust is prepared for smelting was out of commission on account of rebuilding and enlarging. As a result, there is a large tonnage of flue dust in stock and ready for treatment during 1913. The average number of men employed in all of the company's operations was 1315.

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About Shoveling

By Frederick W. Taylor*

Many persons, no doubt, think there is no science in shoveling dirt, that anyone can shovel dirt. "Why," you say, "to shovel it you just shovel, that is all there is to it." Those who have had anything to do with scientific management realize, however, that *there is a best way in doing everything,* and that that best way can always be formulated into certain rules; that you can get your knowledge away from the old chaotic rule-of-thumb knowledge into organized knowledge. And if any one of you should start to find the most important element in the science of shoveling, every one of you with a day's or two days' thought, would be on the track of finding it. You would not find it in a day, but you would know what to look for. We found it after we started to think on the subject of shoveling. And what is it? There are very many elements, but I want to call your attention to this important one. At what shovel-load will a man do his biggest day's work? There must be some best shovel-load; what is it?

The workers of the Bethlehem Steel Co., for instance, almost all owned their own shovels, and I have seen them go day after day to the same shovel for every kind of work, from shoveling rice coal, 3½ lb. to a shovel-load, to shoveling heavy, wet ore, about 38 lb. to the shovel-load. Is 3½ lb. right or is 38 lb. right? Now the moment the question, "What is the proper shovel-load?" is asked under scientific management, it does not become the duty of the manager to ask some one, to ask any shoveler, what is the best. The old style was "John, how much ought you to take on your shovel?" Under scientific management it is the duty of the management to *know* what is the best, not to take what someone thinks.

Determination of Maximum Efficiency

We selected two first-class shovelers. Never examine anyone but a first-class man. By first-class I do not mean something impossible to get, or even difficult to get. Very few people know what you mean when you say first-class. I thing I can explain it to you better by talking about something with which we are all familiar. We know mighty little about men, but there is hardly one of us

*Excerpts from an address delivered at the conference on scientific management at Dartmouth College, Hanover, N. H., in 1911. Published in "Tuck School Conference on Scientific Management."

here who does not know a good deal about horses, because we are in the habit of studying horses. Now if you have a stable full of horses containing large dray horses, carriage horses, saddle horses and so on, and want to pick a first-class horse for hauling a coal wagon, I know every one of you here would take the dray horse. I do not believe any of you would take the trotting horse and call him first-class at all. That is what I mean when I say *first-class man.* If you have a very small stable, when you have a good deal of coal to haul you may have to hitch your trotting horse to a light grocery wagon or even to your buggy to haul coal. But that is not a first-class horse for the purpose, and no one would think of studying a trotting horse hauling a buggy of coal to find what a first-class horse should do in hauling coal. There are many people who say: "You are looking for impossible people; you are setting a pace that nobody can live up to." Not at all. We are taking the men adapted to the work we wish done.

So when we wanted to study the science of shoveling we took two men and said: "You are good shovelers; we want you to work squarely. We are going to ask you to do a lot of fool things, and we are going to pay you double wages while this investigation is going on. It will probably last two or three months. This man will be over you all day long with a stop-watch. He will time you; he will count the shovel-loads and tell you what to do. He does not want you to hurry; just go at your ordinary fair pace. But if either of you fellows tries to soldier on us, that will be the end of it; we will find you out as sure as you are born, and we will fire you out of this place. All we want is a square day's work; no soldiering. If you don't want to take that job, don't, but if you do, we are very glad to pay you double wages while you are doing it." These men said they would be glad to do it, and they were perfectly square; they were ready to do a fair day's work. That was all we asked of them, not something that would tire them out or exhaust them, but something they could live under 40 years and be all right.

The 21-Lb. Shovel

We began by taking the maximum load on the shovel and counting the shovelfuls all day long and weighing the tonnage at the end of the day. I think it was about 38 lb. to the shovel. We found how much those men could do when they were shoveling at 38 lb. to the shovel on an average. And then we got shorter shovels, holding about 34 lb., and measured the tonnage per day, and it was greater than when they were using the 38-lb. shovel. They shoveled more with the 34-lb. shovel-loads than with the 38-lb. shovel-loads. Again we reduced the load to 30 lb., and they did a still greater tonnage; again to 28 lb., and another increase; and the load kept on increasing as we diminished the shovel-load until we reached about 21 lb.; at 21 lb. the man did his biggest day's work. With 20 lb., with 18 lb., with 17 and with 14, they did again a smaller day's work. Starting with a 38-lb. shovel, they went higher and higher until the biggest day's work was done with a 21-lb. shovel; but when they got the lighter shovel the load went down as the shovel-load diminished.

The foundation of that part of the science of shoveling, then, lies in always giving a shoveler a shovel which will hold 21 lb., whatever the material he is using.

A Shovel for Each Kind of Work

What were the consequences of that? In the Bethlehem Steel Works we had to build a shovel-room for our common laborers. Up to that time the men had owned their own shovels. We had to equip this room with eight or 10 different kinds of shovels, so that whatever the man went at, whether rice coal on the one hand, or very heavy ore on the other, he would have just a 21-lb. load. That meant organization in place of no organization. It meant also arranging that each one of the laborers in that yard had the right shovel every day for the kind of material he was going to work on. That required more organization. In place of the old-fashioned foreman who walked around with his men to work with them, telling them what to do, it meant the building of a large, elaborate labor office where three college men worked, besides their clerks and assistants, planning the work for each of these workmen at least one day in advance.

How to Shovel

I suppose you are skeptical about this "art of shoveling," but let me tell you there is a great deal to it. We have found that the most efficient method of shoveling is to put your right arm down on your right hip, hold your shovel on your left leg, and when you shovel into the pile, throw the weight of your body upon the shovel. It does not take any muscle to do that; the weight of your body throws it if you get your arm braced. But if you attempt to do as most shovelers do, take it with your arms and shove into a stubborn pile, you are wasting a great deal of effort. Time and again we found that a man had forgotten his instructions and was throwing the weight of his arms instead of the weight of his body. The teacher would go to him and say, "You have forgotten what I told you about shoveling; I don't wonder you are not getting your premium; you ought to be getting 60% more money. You are falling out of the first class. Now I want to show you again. Just watch the way this thing is done."

The Results at Bethlehem

At the end of about three years we had practically the whole of the yard labor of the Bethlehem Steel Works transferred from the old piece-work and day-work plan to the new scientific plan. Those workmen under the old plan had earned $1.15 a day. Under the new plan they earned $1.85 a day, an increase of more than 60% in wages. We had them studied and a report made. We found that they were practically all sober, that most of them were saving some little money, that they lived better than they ever had before, and that they were as contented a set of men as could be found together anywhere, a magnificent body of carefully selected men. That is what the men got out of it.

What did the company get out of it? The old cost for handling a ton of materials in the yard of the Bethlehem Steel Co. was between 7 and 8c. a ton. The new cost, after all the costs of the clerical work in the office and the tool-room, of the teaching, the telephone system, the new implements and the higher wages, were taken into consideration, was between 3 and 4c. a ton. And the actual cash saving to the Bethlehem Steel Co. during the last year was between $70,000 and $80,000. That is what the company got out of it, and therefore the system is justified from the points of view both of the men and the management.

New Zealand Safety Commission Report

SYNOPSIS—Report of New Zealand commission on health and safety of miners follows accepted standards in its general recommendations. Devotes special attention to the matter of air-vitiation by excessive emanations of CO_2 and to the subject of hot working-places. Recommends regulations covering these points. Follows the lead of other royal commissions in its provisions for controlling miners' phthisis.

The New Zealand Royal Commission on Mines, appointed in 1911 to inquire into and report on the conditions relating to the health and safety of miners, having presented a report, it may be of interest to set forth the recommendations made as regards metal mines. The general recommendations are:

(1) That the maximum height of stopes should be 8 ft. 6 in., measured from the ordinary level of the working-floor of that stope.

(2) If required in the opinion of the mines inspector, all ladderways in constant use for traveling should be lighted by fixed lights in the event of its being difficult to carry an open light.

(3) Sufficient space should be made in all levels at convenient intervals for men to pass trucks.

(4) Speaking-tubes or other method of communication should be provided between levels and shafts or levels and stopes, if over 50 ft. in height.

(5) All ladders in mines should extend for at least three feet above the top of the shaft, platform or landing place.

(6) There should be at least two shafts or outlets to the surface, with which every reef or mineral bed being worked should have a communication not less than three feet wide and three feet high; the outlets not to be at any point nearer to one another than 30 feet.

(7) The use of all tamping other than plastic clay and water should be prohibited, also the use of instantaneous fuses and the practice of charging a number of holes when it is intended to fire only a few at a time.

(8) The adoption of the recommendation of the Transvaal mining commission is advised, which reads: Every working place where rock drills are in use shall be furnished with a James water-blast or suitable appliance for laying and removing the dust, smoke and gases after a blast, and no man shall return to an end, rise, winze or other close place until the air is free from dust, smoke and fumes caused by blasting.

(9) Adequate coverings or penthouses should be provided, extending over the whole area of shafts in course of sinking, sufficient space only being left therein for the passage of any sinking cage, skip, bucket or other means of conveyance; such covering to be situated not more than 50 ft. from the shaft bottom in the case of vertical shafts, or not more than 100 ft. in the case of steeply inclined shafts.

(10) It should be an offense for men to carry tools or timber in ladderways; to throw tools or timber down ladderways; or to take explosives with them on cages.

(11) Whenever possible, dredging and other machinery should be oiled, repaired or adjusted when stationary, and when the conditions do not admit of this, the work should be done by a competent or experienced person; no person engaged in proximity to dredge or mining machinery should wear loose or flowing clothing.

(12) Boilers over 10 years old should be subjected to a hydraulic test.

(13) Pawls and ratchet wheels should be fitted to all mine windlasses, and windlasses or other suitable appliances should be erected in stopes for the purpose of raising tools and timber.

Question of Flows of CO_2 Considered

Regarding the question of ventilation, it is found that in the Hauraki gold field, more especially at Thames, carbon dioxide frequently emanates from fissures in such quantity as to vitiate the air even when fresh air is provided in the amount usually prescribed by law. From this, the commission says, it is evident that a quantity standard should be supplemented by a quality standard as a basis for legislation; and it would be also advisable, for fixing the quantity standard, that mines be classified according to the amount of noxious gases produced by them, and according to the temperature of the surrounding rocks. The minimum amount of air passing into the mine should be of an amount and quality proportionate to the number of men employed underground.

Air Necessary for Cooling Workings

The commission also points out that in deep metal-mining operations it is sometimes necessary to circulate a larger volume of air than is required for breathing purposes in order to reduce the temperature of the rock surfaces. It found in the Waihi and Thames goldfields, an increase in rock temperature of 1° F. was obtained for each 33 ft. and 43.5 ft. of depth respectively, and that the air in the working places was highly saturated, the wet-bulb temperature of the air ranging from 61° to 89° when the outside air had a dry-bulb temperature of 50° to 56.5° in the shade. On the Reefton goldfield the rock temperatures are not nearly so great, the highest temperature recorded, 78° F., wet bulb, being obtained at the 1266-ft. level in the Progress mine.

Air Assumes Rock Temperatures in Seven Minutes

The commission measured the rate of increase in temperature of the outside air when conveyed into deep mines. It ascertained by actual measurement at the Thames mines that atmospheric air which entered a Roots blower at the surface and was forced at a velocity of 10 ft. per sec. through a thin galvanized-iron 22-in. air-pipe down a vertical shaft 1000 ft. in depth and along a crosscut 670 ft., increased in temperature in 2 min. 47 sec. from 55° to 76° F., or at the rate of 7.64° per min. The temperature of the air surrounding the pipe did not exceed 81°. At the Waihi-Grand Junction mine it found that the temperature of the air, while passing from the top to the bottom of a vertical downcast shaft 955 ft., increased from 51° to 56° F., the velocity being 16 ft. per sec. In this case the temperature of the air in the shaft increased at the rate of 5° per min. The return air in the fan passage at the surface of this mine

was 69° and was completely saturated. With these examples as its guide, the commission estimates that the temperature of the air descending into the mine will have attained that of the rock surfaces within seven minutes of entering the shaft.

It is of the opinion that to reduce the temperature in hot working places within reasonable limits, a standard or fixed temperature of 80° F., wet bulb, should not be exceeded, unless it is impracticable to maintain such a standard, in which case a reduction of the hours of employment should be provided for.

Provisions for Ventilation

The commission recommends:

(1) An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless the noxious gases to such an extent that all shafts, crosscuts, levels, stopes, stables and all working places shall be in a fit state for working and passing therein.

(2) A place shall not be deemed to be in a fit state for working or passing therein if the air contains more than 1% of carbon dioxide or less than 19% of oxygen, provided that the Minister of Mines may exempt any mine or mines from the provision, on the ground that they are liable to unavoidable vitiation by carbon dioxide from the rocks during the early stages of development.

(3) Without the permission of the inspector granted in case of impracticability, the maximum temperature of the air in any working place, measured by a wet-bulb thermometer, shall not exceed 80° F. unless blasting has occurred in such place not more than 20 min. previous to the observation of the thermometer.

(4) Mines should be classified according to the amount of noxious gases in the working places and according to the temperature of the surrounding rocks; the amount of air to be proportionate to the number of men and animals employed underground. The total number of men ordinarily employed in any ventilating section should not exceed 50. The amount of air furnished in class *A* mines, i.e., all mining operations on Thames and Waihi goldfields below the 800-ft. level, should be 200 cu.ft. per man per min., minimum, and 500 cu.ft. per min. per horse; and in class *B* mines, comprising other metal-mining operations, 150 cu.ft. per man per min., minimum, and 500 cu.ft. per min. per horse.

Miners' Phthisis Preventive Measures

Dealing with the problem of miners' phthisis, the commission states the preventive measures generally recommended by other royal commissions, namely: (1) The compulsory use of dust-preventing appliances, such as sprays, water-blasts and atomizers; (2) improved ventilation of mines; (3) use of bath and change houses; (4) prevention of indiscriminate spitting and the destruction of tubercular sputum; (5) definite treatment of those affected with tuberculosis of the lungs in an advanced form; (6) improved housing conditions and disinfection of working places and living quarters; (7) the exclusion from underground work of all persons affected with tuberculosis of the lungs.

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Unit Mineral Production of Western Australia—The Geological Survey of Western Australia in Bulletin 50, summarizes the mineral production of that state for 11 years, from 1901 to 1911, inclusive, together with the number of employees, and by division obtains the value of the product per man employed. The results show an average yearly production of $37,274,000, and an average number of men employed of 19,193, which gives $1942 as the annual production per man.

Lake Superior Iron Ore Shipments

The rail shipments of iron ore from the Lake Superior district in 1912 were 776,001 long tons. Adding these to the water shipments, heretofore reported, gives a total of 48,211,778 tons for the year, the highest figures ever reported. The statistics compiled by the *Iron Trade Review* give the following apportionment by ranges, to which are added the total shipments from the first opening to the end of 1912:

Range:	Date Opened	1912 Tons	1912 Per ct.	Total to Date Tons	Total to Date Per ct.
Marquette	1850	4,202,308	8.7	103,332,139	18.0
Menominee	1877	4,711,440	9.8	84,079,407	14.7
Gogebic	1884	4,996,498	10.4	72,735,653	12.6
Vermillion	1884	1,844,981	3.8	33,262,473	5.8
Mesabi	1892	32,047,409	66.5	279,046,135	48.6
Cuyuna	1911	305,111	0.6	452,542	0.1
Baraboo	1903	104,031	0.2	1,191,969	0.2
Total	....	48,211,778	100.0	574,100,318	100.0

Shipments were made in 1912 from 194 mines, of which the Mesabi had 92, Menominee 37, Marquette 28, Gogebic 23, Vermillion eight, Cuyuna four and the Baraboo fields two.

The heaviest shipper last year was the Hull-Rust, on the Mesabi, which reports 2,232,112 tons in 1912, the Leonard being second with 2,198,119 tons and the Canisteo third with 2,099,880 tons. The Hill, which was the leading mine in 1911, with 1,550,568 tons, shipped 1,188,908 tons last year. The Mahoning continued its steady record, shipping 1,518,643 tons.

Shipments from Canadian mines were as follows: Helen, of the Lake Superior Corporation, 48,838 tons; Moose Mountain of Oglebay, Norton & Co., 39,061 tons. The Helen shipped 128,628 in 1911 and 115,790 tons in 1910. The Moose Mountain shipped 6678 tons in 1911 and 72,470 tons in 1910. These figures are not included in the table given above.

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Isle Royale Copper Co.

The report of the directors of the Isle Royale Copper Co. for the year ended Dec. 31, 1912, gave a total production of 8,186,957 lb. of fine copper, sold at an average price of 16.66c. The silver sales amounted to $38,126, making a total income of $1,395,636. Running expenses at the mine were $819,230, construction, No. 7 shaft, exploration, unwatering Huron mines, smelting, freights, commissions and office expenses, bring the total up to $965,591. From this a profit of $430,045 is shown for the year.

The ground opened in No. 2 shaft was much below the average, and the stopes not quite up to the average of the ground mined during 1911.

Exploration by drilling and trenching was undertaken on the supposed horizon of the Kearsarge lode at a point about 2400 ft. from the Isle Royale lode and directly north from the Huron dam and an amygdaloid lode was encountered, which, in the opinion of experts, was the Kearsarge lode. Though some mineralization was shown, no commercial bodies were found. At a point 700 ft. farther north in the hanging wall, diamond drilling and trenching disclosed a second amygdaloid vein, which carried good copper value near the surface, but at depth showed poor vein matter with no copper.

Total assets of the company are given as $736,657, and total liabilities at $178,913, a balance of assets over liabilities of $557,743.

Principles of the Diesel Oil Engine

By Herbert Haas*

SYNOPSIS—The Diesel engine is the most efficient in its use of fuel of all thermal prime movers. Description of the Diesel principle, with figures on cost of a power plant.

The following remarks concerning the Diesel engine are intended for the information of those who have but a limited acquaintance with the workings of this heat engine, and to impart a knowledge of its high fuel economy and the means it offers for the cheap generation of power, information which should be disseminated as widely as possible among mining engineers.

A Million Horsepower in Use

At a general meeting of the National Society of German Engineers (Verein deutscher Ingenieure) in June, 1897, Dr. Rudolph Diesel, the well known German engineer and inventor of the Diesel engine, reported exhaustively on what may be considered the first practical success achieved on a large scale with his engine, and discussed its thermo-dynamic working process and theory. It was in 1892 that Doctor Diesel patented his important invention in all civilized countries, and in 1893, published his classical treatise on the theory and construction of a rational heat engine, to replace the steam engine, and internal combustion engines of today.[1] Since then, the development of the Diesel engine has been rapid, principally in Germany, and with about 1,000,000 horsepower of Diesel engines in operation in all parts of the world, it can be conservatively stated that this engine has long since passed the experimental stage.

Extremely High Fuel Economy

Of the properties which have aided the rapid adoption of the Diesel engine, its unsurpassed fuel economy is undoubtedly the most important. While the best devised modern steam plants convert, under the most favorable conditions, from 11% to 14% of the fuel expended under the boilers into effective work or brake horsepower, properly designed and well built Diesel engines have an average thermo-dynamic efficiency of 33%, i.e., they will develop the same amount of power with one-third to two-fifths the amount of fuel oil used by the most modern steam plants. In small steam plants, with simple engines operating non-condensing, the average efficiency is about 6% and about 10% with compound condensing engines. This is illustrated in the accompanying diagram, from the Koerting-Diesel circular, which shows the proportion of fuel wasted, and the relatively small amount converted into effective work. Of each dollar spent in fuel, about 6c. is converted into effective work in the single-cylinder noncondensing steam engine, 10c. in the compound condensing engine, 14c. in the most modern, largest and best equipped steam plants, and 33c. in the Diesel engine.

The above represents average practice and economy, under full load, while Fig. 2 shows the heat balance of different heat engines under best conditions, as well as the influence of size of engine unit on fuel economy.[2]

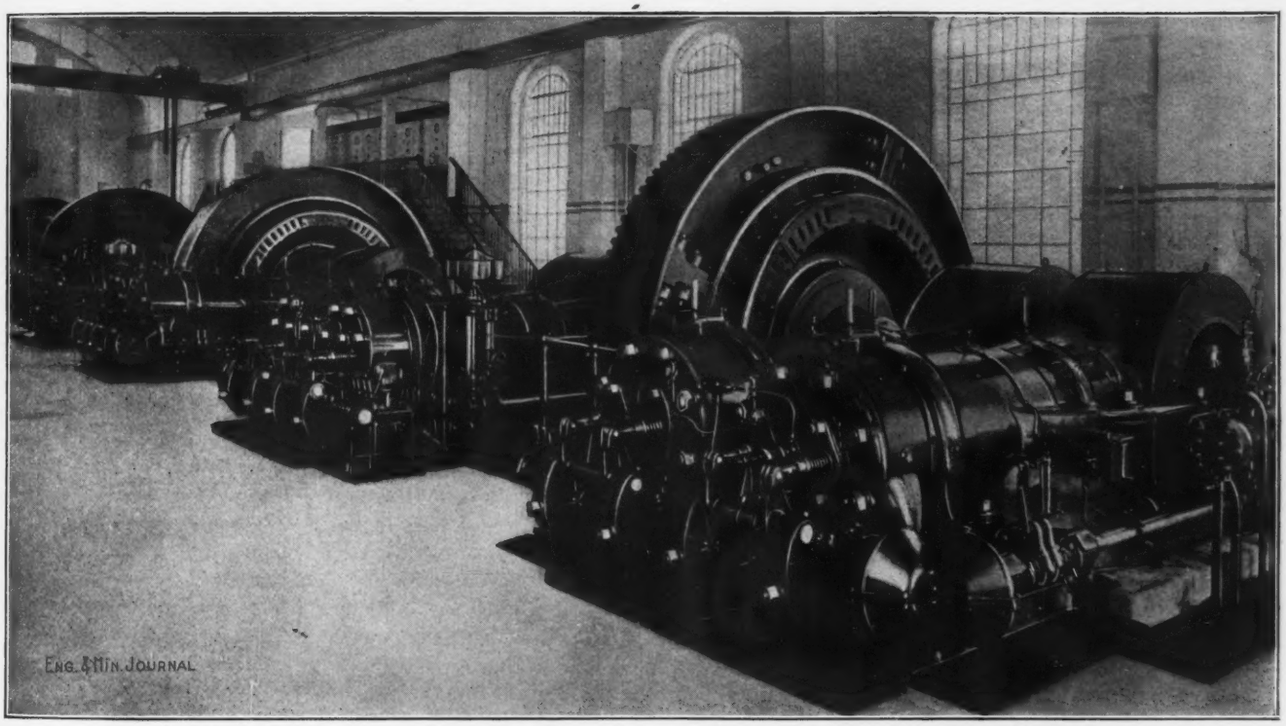


Fig. 1. 600-Brake-Horsepower Diesel Units

*Mining and metallurgical engineer, San Francisco, Calif.

[1]"Theorie und Konstruktion eines rationellen Warmemotors zum Ersatz der Dampfmaschinen und der heute bekannten Verbrennungsmotoren." R. Diesel, Verlag Julius Springer, Berlin. Also A. Naegel, "Die neuere Entwicklung der ortfesten Oelmaschine," "Zeit. des Vereines deutscher Ing.," Vol. 55, No. 32, Aug. 12, 1911.

[2]F. Barth, "Die Wahl einer Betriebskraft," "Zeit. des Vereines deutscher Ing.," Vol. 56, Nos. 40, 41, 42, Oct., 1912.

It should be stated that inasmuch as the oil is burned directly in the Diesel engine, operating the air compressor and air pump, it represents the total fuel used per brake or effective horsepower. Therefore a comparison with the steam engine must also be on a basis of total fuel consumption per effective, and not indicated, horsepower, so as to include boiler losses, power required for auxiliaries, boiler feed, vacuum, and circulating pumps, and the large heat losses in condensing, as a portion of the fuel initially expended under the boilers for a given power output is thus used.

Operation at Fractional Loads Involves Small Fuel Increase

Another remarkable characteristic of a properly designed and well built Diesel engine is the slight increase

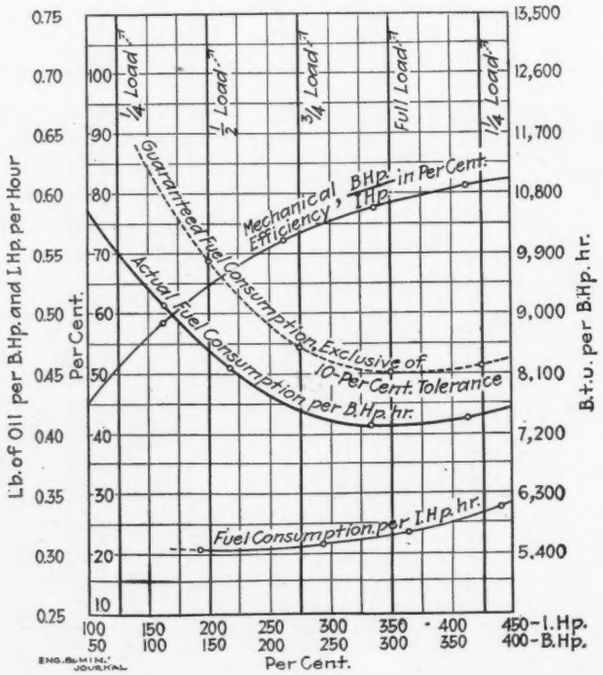


Fig. 2. Diesel Efficiencies under Varying Conditions

in fuel consumption when operating at fractional loads; thus with a total net thermal efficiency of 35% at full load, this remains still 33% at three-fourths load and drops only to 28% at half load. The low fuel consumption secured with a Diesel engine under test conditions is only slightly exceeded in actual operation under average operating conditions. In this respect it differs radically from steam and producer-gas power plants, the fuel consumption of which during extended operating periods, which include stand-by and banking losses, greatly exceeds that guaranteed and secured under test conditions.

The economy of the Diesel engine plant does not depend so much on the skill of the operator, as does steam power plant, but is chiefly the result of engine characteristics, which are automatic in nature. High fuel economy alone would not give the Diesel engine its great economic importance as a prime mover, if it were not for the fact that it uses the cheapest available fuels, such as coal tars, tar oils, and crude oils and their residues.

Compression Heat Ignites Fuel

In this engine use is made of the well known physical property of air of becoming heated when compressed. The compression in the Diesel engine cylinder is carried to such a point that a high temperature, 1000° F. and higher, is imparted to the air and into this "red-hot" atmosphere, the liquid fuel is injected under still higher pressure. The heated air causes the ignition of the injected fuel without any sudden explosion and the burning process is gradual. The ignition is therefore made without any mechanical means such as electrical or other sparking devices, hot balls, etc.

An accompanying illustration shows a Diesel engine in plan and elevation. This particular engine operates on the four-cycle principle, that is, the engine receives a working impulse with every alternate revolution. On the outward or intake stroke, air is admitted through the mechanically controlled air-inlet valve *A*. On the inward or return stroke, this air is compressed to about 450 to 500 lb. per sq.in. and becomes highly heated. A few degrees before the completion of this compression stroke,

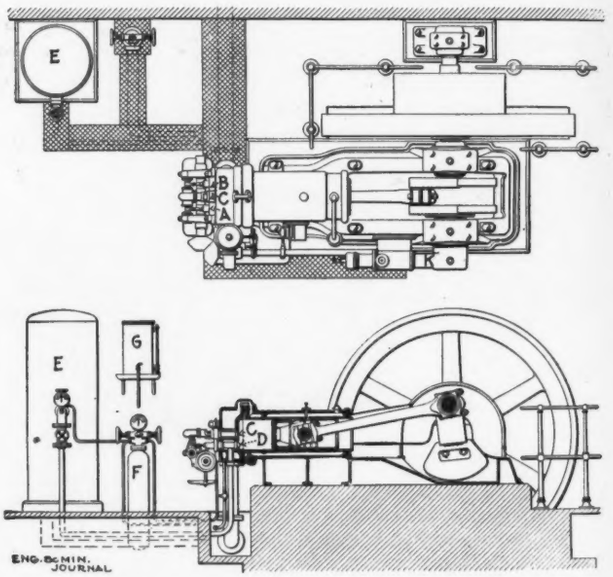


Fig. 3. Plan and Elevation, Diesel Engine

the liquid fuel is injected into the engine cylinder through the fuel-oil injection valves and atomizer *C* by means of highly compressed "injection" air furnished by an independent high-pressure compressor *K* and stored in the air bottle *F* from which it is supplied to the fuel-oil injection valve *C*. This high-pressure injection air atomizes the oil completely and breakes it up into a mist which, on being mixed with the hot atmosphere of the engine cylinder, is burned and gasified. The gases, on forcing the piston forward, expand gradually, very much as steam would expand in a cylinder after having been cut off.

On the discharge stroke, or the fourth stroke, the burnt gases are expelled through the discharge or outlet valve *B* into an exhaust tank or through an exhaust silencer into the atmosphere. The piston sweeps all gases before it and acts as an efficient scavenger. The action of the engine as a scavenging pump during the fourth stroke is important in that the air taken in on the next stroke (first stroke) beginning the repetition of the above cycle,

will not become mixed with any of the products of combustion, an occurrence which would not only decrease the efficiency of the engine, but might cause pre-ignition if any incompletely burnt gases should be present.

Engine Started by Air Pressure

The injection air furnished by the compressor *K* is stored in the injection-air bottle *F* at a pressure of about 900 lb. per sq.in., at which pressure the fuel oil is injected into the engine cylinder. A portion of this injection air is diverted from the injection-air bottle *F* to the air receiver *E* in which it is kept at about 220-lb. pressure. For starting the engine, air from this air receiver *E* is supplied through a pipe connected with the starting valve *D*, placed below the fuel-oil injection valve. It is mechanically operated by the same cam shaft that controls and operates the air-inlet and exhaust valves. The valve is provided with a spring and unloading plunger, and admits the compressed air during the starting of the engine only as long as the pressure in the engine cylinder is lower than that of the compressed air used for starting. To permit the use of air at a lower pressure, 100 lb. instead of 220 lb. per sq.in. for starting the engine, the compressed air produced in the engine cylinder while starting is automatically released through the exhaust valve *B* by means of an auxiliary cam. After the engine is speeded up and the pressure in the cylinder is greater than that of the air used for starting, then the cam shaft with the cam that operates the starting valve, *D*, and the auxiliary cam that engages the exhaust valve *B* are shifted; the starting valve *D* is thrown out of action, and the valves *A*, *B* and *C*, used while the engine is running, come into action in their regular sequence. This makes a small volume of low-pressure air sufficient to start the engine.

Starting Air Furnished by Engine in Operation

As soon as the engine is running "under oil," the throttle valves on the compressor are opened full and a portion of the air delivered to the injection-air bottle *F* is diverted to the air receiver *E*, the compressor as a rule being of a capacity to refill the receiver *E* in 15 to 20 min. Whenever a portion of the air in the receiver *E* has been used for starting purposes the air receiver should be re-filled as soon as the engine is in regular operation.

The tank *G* contains the day's supply of fuel oil which flows by gravity to the fuel pump of the engine. The tank is supplied with a filter on which any sand, grit or foreign matter in the oil is collected.

The pump which supplies the fuel oil to the injection valve is a precision pump operated from the valve gear and governor shaft. The amount of oil delivered to the fuel-injection valve is precisely proportioned to the load on the engine by an automatic sensitive governor. This fuel pump does not have to work against any pressure save that produced by the small head, (about one to two feet) and the friction in the pipe connecting this pump with the reservoir in the fuel-oil injection valve. The oil is forced to this reservoir during the first stroke of the cycle.

The injection-air bottle *F* is usually supplied charged with highly compressed air as a portion of the engine equipment furnished by the manufacturer and this air is used to start the engine for the first time after its installation. After the engine has once been placed in operation, this injection air is furnished from the compressor *K*, which thereafter supplies the required air for injecting the fuel oil as well as for starting the engine.

Atomized Fuel Completely Consumed

A consideration of this working process makes apparent the necessity of high compression in the engine cylinder. Of equal importance is the complete atomizing of the fuel oil, for which highly compressed air of 850- to 900-lb. pressure is required. Both are necessary for securing a high thermal efficiency as well as to make it possible to burn heavy fuel oils and their residues, coal tars, and coal-tar oils, in the very short time available.

The exhaust is colorless and odorless, the engine fulfilling all hygienic requirements. The highly compressed injection air is not only necessary for injecting the fuel oil into the engine cylinder but also for breaking up the heavy oil into a mist so that it is mixed with the heated atmosphere in the engine cylinder, burnt and converted into gas. As all of the oil injected into the engine cylinder should be completely oxidized before the piston has been forced forward more than 20° to 30°, or one-ninth to one-sixth of a complete working stroke, this oil must be burned in the short time of one-forty-fifth to one-thirtieth of a second in an engine running with the moderate speed of 150 r.p.m. In an engine running at the high speed of 300 r.p.m., the time allotted for burning this oil is one-ninetieth to one-sixtieth of a second.

Diesel Power Impulse Not Explosion

In this connection, it is well to compare the essential difference between the ordinary petroleum, gasoline, or distillate engine, working on the so called Otto cycle, with the Diesel engine. In the former type, light oils, distillates of the crude oils, are broken up into a spray and mixed with air in a chamber which is known as a "vaporizer" and which is connected with and forms part of the combustion chamber or working cylinder of the engine. This inflammable and explosive mixture of petroleum vapor and air is drawn into the engine cylinder, whereas in the Diesel engine, pure air is admitted for the same corresponding stroke. The compression of this inflammable and explosive mixture on the return stroke or second cycle, in the Otto principle, must be kept low to prevent it from being heated to a point at which pre-ignition, which is highly objectionable, would result. This compressed mixture of petroleum and air is ignited by a sparking device of one form or another just before the completion of the compression stroke. There is a resulting explosion, the pressure rises rapidly and then falls off gradually as the gases expand. Any missed ignition results in the discharge of the unburned gas mixture which should have produced a working impulse, and the fuel is wasted. Missed ignition, as well as low compression, results in unburned or incompletely burned gases which, discharging into the exhaust, are likely to be fired by the exhaust products from the following charges, producing explosions in the exhaust pipes. All these irregular explosions are highly objectionable, giving constant shocks to the engine and seriously interfering with regular running. It has been a long-recognized fact that the economy of the internal-combustion engine increases with the compression. In all internal-combus-

tion engines where a mixture of inflammable gas and air is compressed, the compression is limited in order to prevent pre-ignition.[3]

In the Diesel engine, all of these objectionable features have been overcome, and it is today the heat engine most nearly approaching ideal conditions. Taking air into the cylinder, instead of an explosive mixture of air and petroleum vapor, the air, which contains no inflammable gas, can be highly compressed, thereby heating it to a high temperature. This highly heated air furnishes the means of igniting the heavy fuel oil when it is injected, as well as the oxygen required for combustion, and insures unfailing automatic ignition without mechanical igniters, electric or other sparking devices, eliminating the missed ignitions, so common in distillate engines.

The difference between the Otto and Diesel cycles is well illustrated in the indicator cards shown. This difference is further reflected in the amount of fuel used by high-grade Diesel engines and by distillate and gasoline engines under average operating conditions. Thus a high-grade Diesel engine uses about half as much fuel as distillate and gasoline engines to develop the same power. Distillate being about five times, and gasoline 10 times more costly than the crude fuel oils or residues burned by the Diesel engine, its real fuel economy is 10 to 20 times greater than that of distillate or gasoline engines.

Diesel Engines May Operate on Two-cycle Principle

The foregoing description deals with the four-cycle, single-acting Diesel engine. The two-cycle single-acting engine receives two working impulses to one of the four-cycle single-acting engine, or one working stroke with every revolution.

In this type of engine a scavenging pump operated direct from the main engine, furnishes the air required for clearing the working cylinder of its burnt gases, and for filling it with fresh air, which is then compressed on the return stroke of the piston. The exhaust valves are usually built circumferentially into the cylinder wall in form of open slots, which are opened to the combustion products in the cylinder as soon as the piston, acting as a slide valve, has moved past and beyond them on the completion of its stroke. At the same time the exhaust ports are opened, air from the scavenging pump is admitted through mechanically operated valves at the opposite end of the cylinder, usually in the cylinder head, and sweeps before it the products of combustion, leaving the cylinder filled with fresh air, which is then compressed on the return stroke of the piston.

The two-cycle engine, being more complicated than the four-cycle single-acting engine with air-cooled trunk piston, and having fully 10% higher fuel consumption, will be restricted in use to large engine units, from 1000-upward, and for large power plants. However, it has the advantage of saving considerably in weight. For marine purposes where saving in weight is of great importance, the four-cycle engine is limited to units of about 1000-b.hp., above which the two-cycle engine has the preference; and above 150 b.hp. per unit, the use of the four-cycle engine is precluded. The two-cycle engine is also less complicated where reversing is necessary, as in marine work.

[3]W. Robinson, "Gas and Petroleum Engines," Vol. I and II.

Double-Acting Engines Complicated

The four-cycle double-acting engine, single-tandem (two cylinder) or cross-tandem (four cylinders), requires water-cooled pistons, piston and tail rods and stuffing boxes, and an increased number of working parts, all of which tend to complicate the design, and place serious restrictions on the quality and the kind of fuel oil that can be used, especially as regards the sulphur content of such fuels. As Californian and especially Mexican crude oils are high in sulphur content, 3% to 3½% being common, there will probably be corrosion of the engine cylinder, piston, and valves, due to condensation of the sulphurous acid, on the water-cooled engine parts, which action is greatly increased by the smallest leak. With the air-cooled trunk piston, aside from simplifying the construction greatly, this corrosion is prevented. The valve seats and valves are provided with renewable armatures of composition metal which can be cheaply replaced should they become pitted after prolonged use.

For general mining purposes in the West, the use of any other than the four-cycle single-acting engine for plants below 3000 or 4000 hp. is practically precluded, as simplicity in construction, reliability and continuity of operation in remote mining districts will receive first consideration.

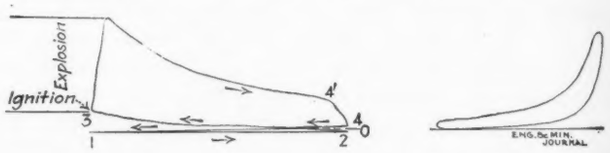


Fig. 4. Otto and Diesel Indicator Cards

To avoid any misconception it is well to emphasize the fact that the difficulties and the considerable fuel losses during exhausting experienced with the usual two-cycle gas engine, chiefly on account of the successive scavenging and loading of the engine cylinder, are absent in the two-cycle Diesel engine. In this engine the same air pump does the scavenging and loading, whereas in the two-cycle gas engine, separate pumps are used for scavenging and charging the cylinder with the gas-and-air mixture. Having to deal with inert air and a liquid fuel, the working process of the two-cycle Diesel engine is much simpler than that of the two-cycle gas engine.

Fuel Consumption Per Horsepower Less Than One-half Pound

Fuel consumption varies within narrow limits with different sized engines. Well designed, carefully built, high-grade engines consume less than 0.5 lb. of fuel oil per brake-horsepower-hour, at full load, even in the smallest engines (20 hp.), and a consumption as low as 0.40 lb. per brake-horsepower-hour at full load, in an engine of 80 hp. in one cylinder has been obtained.

Fuel consumptions are figured on a basis of a fuel oil with a mean lower heat value of 18,000 B.t.u. per lb. to which basis the heat value of the fuel used in the Diesel engine is reduced.

The cooling water required for Diesel engines is from 2½ to five gallons per hour, less water being required with an increase in the size of the engine. With a cooling tower this can be reduced to about one-fifth of the above quantity.

For a classification of suitable fuels for the Diesel engine I refer to a paper read by Dr. R. Diesel before the Institution of Mechanical Engineers of Great Britain, Mar. 15, 1912, and reprinted in *Engineering News*, Apr. 4, 1912, also to his paper[4] before the Verein deutscher Ingenieure.

Careful Design and Construction Important

Next in importance to the use of the best materials for construction and good workmanship and design, the use of mechanically operated valves accurately timed and positively controlled is essential to economy. Minimum clearance space insures good scavenging of the cylinder and avoids unnecessary engine losses. Efficiency demands a two- or three-stage, water-cooled compressor, driven direct from the main engine with intercooling of the air between stages. For safety, the air should be freed of oil before it enters the second stage, and is therefore passed through the oil separator.

A Power Plant of Three Units

In the following estimate a central electric-power plant is contemplated consisting of three horizontal Diesel engines of 600 brake-horsepower each, directly connected to 450-kv.a. alternators running at 150 r.p.m., generating three-phase, 60-cycle, 2400-volt, alternating current, and the necessary standard switchboard equipment, but without step-up or step-down transformers. The building is of steel frame and reinforced concrete construction, equipped with crane runway, and 10-ton hand-operated crane. The cost of such a plant can be placed conservatively at $160,000, based on western prices of labor and material, which is a little less than $135 per kw. capacity installed.

Amortization is based on a life of 15 years for the plant and is therefore figured at 7½% without compounding, and interest on the invested capital at 5%, or a total of

$$\frac{\$160{,}000 \times 12\frac{1}{2}}{100} = \$20{,}000$$

per year, of which $8000 is for interest, and $12,000 for amortization.

The operating force of the plant consists of one chief engineer at $250 per month, $250; three watch engineers at $120 per month, $360; three oilers at $75 per month, $225; three switchboard men at $75 per month, $225; total per month, $1060, or $12,720 per year.

TABLE I. COSTS OF GENERATING ELECTRIC POWER WITH THREE 600-B.HP. DIESEL UNITS

Cost of generating current with three 600-b.hp. horizontal Diesel engines, direct connected to 450 kv.a. alternators. Losses in generators, current required for excitation and transmission losses are included, and cost is for current delivered to switchboard.

	I			II			III			IV		
	15,500,000 B.hp.-hours			12,000,000 B.hp.-hours			8,640,000 B.hp.-hours			6,910,000 B.hp.-hours		
	11,600,000 Kw.-hours			8,800,000 Kw.-hours			6,440,000 Kw.-hours			5,160,000 Kw.-hours		
	Supplies	Cost per Year	Cost per Kw.-hour	Supplies	Cost per Year	Cost per Kw.-hour	Supplies	Cost per Year	Cost per Kw.-hour	Supplies	Cost per Year	Cost per Kw.-hour
Labor		$12,720	0.1097c.		$12,720	0.1445c.		$12,720	0.1973c.		$12,720	0.2465c.
Fuel, bbl.	23,200	34,800	0.3000c.	17,600	26,400	0.3000c.	12,880	19,320	0.3000c.	10,320	13,480	0.3000c.
Lubrication, gal.	17,400	7,830	0.0675c.	13,200	5,940	0.0675c.	9,660	4,347	0.0675c.	7,790	3,505	0.0675c.
Maintenance		5,000	0.0431c.		4,500	0.0501c.		3,500	0.0543c.		3,000	0.0581c.
Total direct cost		$60,350	0.5203c.		$49,560	0.5621c.		$39,887	0.6191c.		$32,705	0.6721c.
Interest at 5%		8,000	0.0690c.		8,000	0.0909c.		8,000	0.1241c.		8,000	0.1550c.
Amortization at 7½%		12,000	0.1034c.		12,000	0.1364c.		12,000	0.1861c.		12,000	0.2325c.
Total cost		$80,250	0.6927c.		$69,560	0.7894c.		$59,887	0.9293c.		$52,705	1.0596c.

Electrical Current Generated Cheaply

The cost of generating electrical current through Diesel engines depends partly on the labor cost per kilowatt-hour, which is greatly influenced by the size of the power plant, and largely by the ratio of the average power output during one year to the actual quantity which it is capable of delivering. Interest and amortization charges likewise increase with a lowering of the load factor. The unit power cost, therefore, increases rapidly with a decrease in the station's maximum power output.

The fuel consumption of Diesel engines is practically uninfluenced by the size of the unit, while with steam engines the fuel consumption increases rapidly with a decrease in their size below 200 hp. A 1000-hp. Diesel engine, has no lower fuel consumption per brake-horsepower-hour, than one of 100 hp. In a Diesel engine plant with two or more units, the fuel consumption per brake-horsepower-hour or kilowatt-hour, remains practically constant, because the units may be quickly put into or removed from service. The time required for starting the engine is but a few minutes, consequently the units may be operated in rotation at full load, or nearly so, and at their best economy.

Maintenance Costs Are Low

Fuel is figured to cost $1.50 per bbl. Its heating value is placed at 18,500 B.t.u. per lb., and as one barrel will deliver, on an average 500 kilowatt-hours to the switchboard, the fuel cost can be placed at 0.30c. per kilowatt-hour.

Average consumption of lubricating oil, is 0.008 lb. per brake-horsepower-hour. Its cost is figured at 45c. per gal., so that a 600-b.-hp. unit uses 4.8 lb. per hr. As well designed Diesel engines are equipped with force lubricating systems, consisting of a pump which circulates the lubricating oil through all bearings and forces it through a filter and oil cooler to return it to the bearings, the oil consumption would be considerably less than here stated. Such a lubricating system works independently of the oil-lifting rings of the principal bearings, supplying all bearings constantly with oil, even if oil rings should stick or fail.

Provision of $5000 per year for spare parts, repairs, and supplies, will be liberal for a plant of the size here contemplated. This figure is based on prolonged cost records of Diesel engine power plants. The costs are based on the following operating conditions:

[4] "Ueberblick über den heutigen Stand des Dieselmotorbaues und die Versorgung mit flüssigeng Brennstoffen." "Zeit. des Vereines deutscher Ing.," Vol. 55, No. 32, Aug. 12, 1911.

I. Operating all 3 units, day and night: 3× 600 hp. × 24 hours × 360 days = in round numbers 15,500,000 horsepower-hours or 11,600,000 kilowatt-hours.

II. 3 units working 8 hours daily, from 5 p.m. until 1 a.m.
2 units working 16 hours daily, from 1 a.m. until 5 p.m.
8 × 3 × 600 hp. = 14,400
16 × 2 × 600 hp. = 19,200

33,600 × 360 days = in round numbers 12,100,000 horsepower-hours, or 8,800,000 kilowatt-hours.

III. 3 units working 8 hours daily, from 5 p.m. until 1 a.m.
1 unit working 16 hours daily, from 1 a.m. until 5 p.m.
8 × 3 × 600 hp. = 14,400
16 × 1 × 600 hp. = 9,600

24,000 × 360 days = in round numbers 8,640,000 horsepower-hours, or 6,440,000 kilowatt-hours.

IV. 2 units working 8 hours daily, from 5 p.m. until 1 a.m.
1 unit working 16 hours daily, from 1 a.m. until 5 p.m.
alternately one unit is kept constantly in reserve.
8 × 2 × 600 hp. = 9,600
16 × 1 × 600 hp. = 9,600

19,200 × 360 days = in round numbers 6,910,000 horsepower-hours, or 5,160,000 kilowatt-hours.

The load here considered does not fluctuate frequently nor suddenly, but is fairly uniform during the periods considered.

For loads subject to excessive variations, the fuel consumption would be higher per kilowatt-hour than the

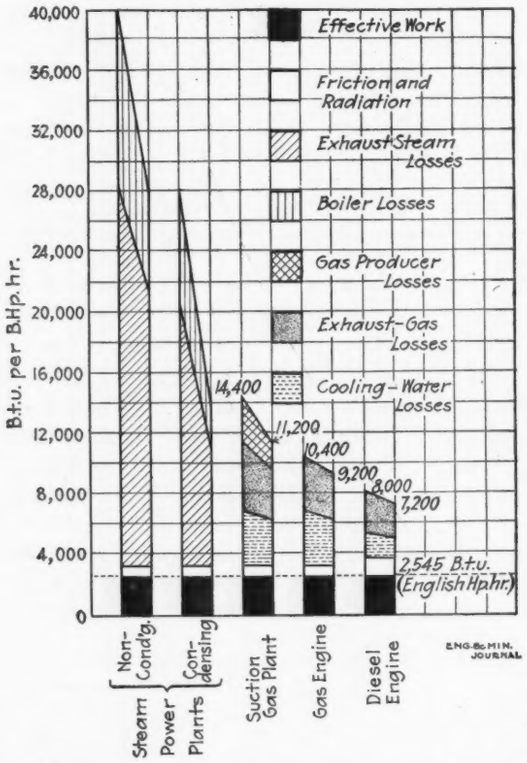


FIG. 5. COMPARATIVE EFFICIENCIES OF PRIME MOVERS

above. The operating conditions pertain to a lighting plant or to a central power station supplying current to mine and mill. As the mines are usually operated during two shifts, from 7 a.m. until 3 p.m., and from 6 p.m. until 2 a.m., whereas the mill is operated continuously during 24 hr., a plant having three units of identical size, two of which are of sufficient capacity to supply the mill load, and the third to supply the mine load, offers great advantages. Provision is thereby made for alternately shutting down one unit for a total of eight hours in 24, maintaining continuous efficiency of the engines.

For very large power plants, steam turbo-generators are not apt to be displaced by the Diesel engine. This is especially true where fuel is cheap and the load factor of the plant low.

The steam turbine, on account of its high rotative speed, is the ideal prime mover for alternators. Its great flexibility due to large overload capacity, and lower installation cost per kilowatt than that of the Diesel engine plant, will give the large installation, from 500-kw. upwards, the economic preference wherever fuel is cheap and the station operates with a low load factor, for in such cases capital charges are materially less with the turbine and offset any saving in fuel possible with the Diesel installation. Frequently, a combination plant, in which the Diesel engine is operated continuously at a favorable load factor, and the turbine is used to supply the peak loads only, offers large economies in fuel. The waste gases from the Diesel engine are then passed under the boilers, sufficient gas being frequently supplied to keep these up to pressure.

Conversely, with an increase in the price of fuel and a better load factor the Diesel engine plant gains in economy and a decision either for a turbine or a Diesel engine plant should be reached only after careful determination of the unit power cost.

As units up to 6000 b.-hp. in one engine, are now being built in Germany, the Diesel engine will also be available for the largest central stations.

Small Diesel engine plants will easily have the preference over small steam-turbine plants in view of their greater economy and other advantages already outlined.

Hedley Gold Mining Co.

The report of the Hedley Gold Mining Co. for 1912 shows that the mill has treated 70,455 tons of ore having an average value of $11.19 per ton. An extraction of 95% of the gold was obtained.

The increased tonnage produced used up practically all the available power so that development work was curtailed; nevertheless, the usual reserve of 10,000 tons of broken ore has been maintained. Mining below the No. 4 tunnel level has proved that the orebody indicated by diamond drilling last year is a valuable addition to the reserves. An incline shaft has been sunk 420 ft. on the ore, three levels opened and a fourth started. This ore is 16 ft. between walls and has an average value of $14 per ton.

A section of the ground under the Nickel Plate ore beds has been proved by diamond drill, and also another section to the north. This work was not started until July, but seven holes were finished by October, three of which were in good ore. The last two holes were discontinued before entering the ore zone, owing to freezing of the water lines. The ore reserve in the Nickel Plate and Iron Duke claims is said to be 413,000 tons and to average $11.35 per ton.

The cost per ton for mining and milling has been reduced 53c. and the total cost 73c., although higher wages have been paid. The mill has been kept in first-class repair and is doing good work. The affairs of the company are reported as satisfactory.

The Ragland Oil Field in east-central Kentucky was discovered in 1900, according to Bull. 531-A of the U. S. Geological Survey. Oil is found in the Corniferous limestone which lies at a depth of 320 to 800 ft. below the surface. Up to October, 1909, about 200 wells had been drilled in the field, of which 135 were oil-producing. The largest daily production of a single well is reported at about 220 bbl., that of all the others ranged from one to probably 30 bbl. per day. A number of wells have been abandoned within the last three years and there are many others which pay little more than the cost of operating them.

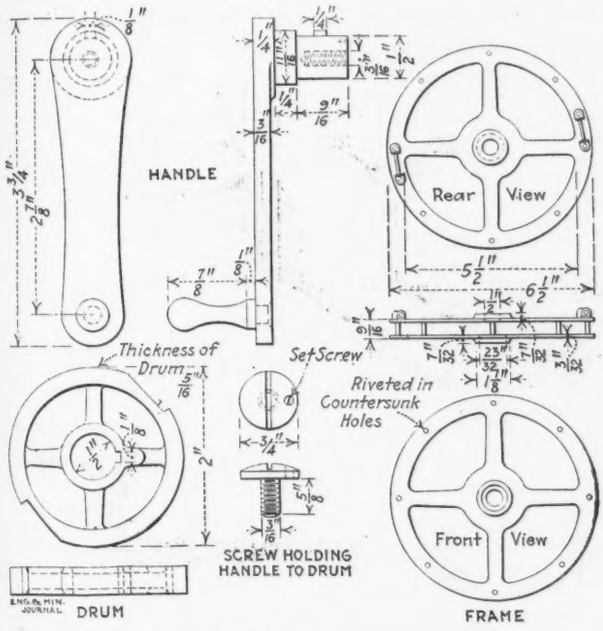
DETAILS OF PRACTICAL MINING

Reel for Underground Tape

By Charles H. Scheuer*

Experience with several varieties of tape reels in underground work led finally to the adoption of the Purdue model, manufactured by the Keuffel & Esser Co. It was found that considerable annoyance was experienced from the loosening of the screws, several of which entered into its construction.

To remedy this, certain improvements were described to the manufacturers and the reel shown in the detailed drawing was made up. The particular changes are: An



Reel for 100-Ft. Underground Tape

enlargement of the diameter so as to accommodate a muddy tape; the substitution of countersunk rivets for screws through the spreader washers between the two sections of the frame; the use of a countersunk riveted knob for the handle knob instead of a swiveled and screwed ring; and the fastening of the handle into the drum by a flat-headed screw, itself fastened by a setscrew. The result is a rigid and durable reel which can be taken apart as far as necessary by loosening the setscrew, removing the flat-headed screw and so releasing the handle from the drum. For a 200-ft. tape, the diameter should be increased to 7½ in. in the clear.

Electrical Cables for Sinking Pumps must be extremely flexible, according to E. Kilburn Scott, in a paper read before the Association of Mining Electrical Engineers, of England, Feb. 7, 1913. Rubber would seem to be the most available insulating substance for such cables, as being flexible, resistant to water, and if the siliceous rubber used for vehicle tires be applied on the outside, resistant also to wear and abrasion.

*Chief engineer, Fayal district, Oliver Iron Mining Co., Eveleth, Minn.

Sconces for Holding Candles

While acetylene is used in some mines and grease lamps in others, there are many in which candles are used and will be for some time. Mine fires can frequently be traced to a candle source.

It is not the candle that the miner is using himself, but the auxiliary lights at some chute, turn or bad place in the run from the ore pile to the chute that cause mine fires. The miner takes home his candlestick but frequently forgets to put out the auxiliary lights. He cannot be expected to provide candlesticks for these, and, furthermore, a candlestick is little safer than the two nails driven into a timber, which are usually used.

The proper method of holding these auxiliary lights is in a sconce, an old Cornish device. As the name implies, it is simply a candle holder, fastened to the side of an upright timber. To receive the candle, it should have a holder or socket preferably split so that the miner can easily dig out any old snuff; it should have a back to protect the timber from the flame; and it is also well for the bottom to have a raised lip to catch the drippings. The candle cannot drop out as it burns down, and so fall to the floor. The bottom plate catches the drippings and prevents a large accumulation.

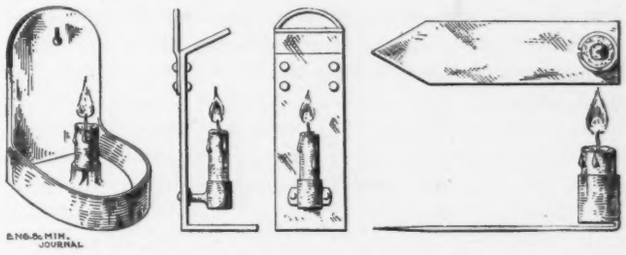


Fig. 1. Fig. 2 Fig. 3

Different Types of Candle Sconces

A sconce used in the mines of the Copper Queen company at Bisbee, Ariz., is shown in Fig. 1. This is a cast-iron affair made heavy to resist rough usage. The socket is cast split, and the hole for hanging on the nail is made like a key-hole with the large part down, so that the sconce cannot easily be knocked off. These cast-iron sconces, however, must be made at a foundry; they are also broken frequently at the nail hole. The lighter sheet-metal sconces are preferable as being less liable to break and capable of being made at any blacksmith shop at odd times out of scrap plate.

A good type of sheet-metal sconce is that illustrated in Fig. 2, used at the Highland Boy mine at Bingham, Utah. This is equipped with a handle at the top for carrying purposes. The sheet-iron frame of the sconce bends out at the bottom to catch the drippings, while at the top it is flared to keep the flame from reaching a cap when the sconce is hung high on the post. The candle is held in a socket riveted to the frame, the bottom of the socket being closed so that a snuff cannot fall through.

A simpler sconce is the one used at the Lake mine of the Cleveland-Cliffs Iron Co. at Ishpeming, Mich., shown in Fig. 3. This was devised by Captain Collick, of the Lake mine, and is simply a piece of sheet iron sharpened at one end to stick into a timber while at the other end the metal has been turned up and bent into a socket about 1 in. high to hold the candle. As it is 8 or 9 in. long, there is no danger of the flame striking the timber. The drippings fall to the floor, which is somewhat of a disadvantage.

A still cheaper sconce can be made from an old lard pail. The sheet forming the sides of the pail is straightened out and serves as the plate to keep the flame from the timber. Back of this and at its bottom comes up the bent-up heel of the bottom of the pail. These two are nailed in that position on the post by the two nails that serve as the candle holder in this sconce. The bottom piece is bent up to form a trough to catch the candle drippings and to retain the candle snuff if it should be allowed to burn down to the nails and fall. This crude sconce is in many ways as good as the more elaborate ones.

The use of sconces after the men have become accustomed to them eliminates the necessity of having a "firebug" go through the stopes at the end of the shift to look for lighted candles that may have been left, a common practice in dry mines.

Rules of Thumb for Metric Conversion

Certain approximate relations between common metric units of measurement and their English equivalents exist. Albert A. Cary presents these in *Power,* Feb. 18, 1913, in the form of the following handy table:

Dimensions etc.	Unit Used	Converted to	Rule
Weight	Kilogram	Pounds	Multiply by 2 then add 10 per cent.
Length	Meter	Feet	Add 10 per cent. then multiply by 3
Surface	Square meter	Square feet	Add two 10 per cents, then multiply by 9
Volume	Cubic meter	Cubic feet	Add three 10 per cents, then multiply by 27
Capacity	Liter	Quarts	Add one-half of 10 per cent. (or 5 per cent.)
Temperature	Centigrade	Fahrenheit	Multiply by 2; subtract 10 per cent., then add 32
Heat	Calories per kilogram	B.t.u. per pound	Multiply by 2, then subtract 10 per cent.
Heat	B.t.u. per pound	Calories per kilogram	Multiply by 0.556 (or divide by 6 and then by 3)
Pressure	Kilograms per square centimeter	Pounds per square inch	Multiply by 14.223 or divide by 0.07
Pressure	Pounds per square inch	Kilograms per square centimeter	Multiply by 0.07
Evaporation	Kilograms per square meter	Pounds per square foot	Divide by 5
Evaporation	Pounds per square foot	Kilograms per square meter	Multiply by 5
Distance	Kilometers	Miles	Multiply by 0.6 and add 5 per cent. of the product
Distance	Miles	Kilometers	Multiply by 1.6
Capacity	Cubic centimeters	Cubic inches	Divide by 16 (or by 4 twice)
Capacity	Cubic inches	Cubic centimeters	Multiply by 16

The rules are so simple as to be easily carried in the head, but for accurate results more complicated factors must be employed.

A Two-speed Alternating-current Motor is used to drive the fan at the Keystone coal mine near Greensburg, Penn. At this mine the number of miners on night shift is much less than on day shaft, so the demands upon the ventilating fan are correspondingly smaller. To meet this condition a two-speed Westinghouse induction motor with a rating of 7½ hp. at 600 r.p.m. and 15 hp. at 1200 r.p.m. was installed to drive the fan. The change in speed is made at the controller. By this installation a substantial saving in power was accomplished.

Diamond Prospecting and Washing Devices

The discovery of diamonds in Michigan and Wisconsin in the glacial drift has led to the suspicion that they may be found in greater quantities in Canada. Prospecting has been carried on to some extent, but, since most prospectors probably use methods suitable for gold, it is possible that some diamond deposits may have been overlooked. Inasmuch as the specific gravity of diamond is 3.52, while the specific gravity of gold varies from 15 to 19.3, the same appliances and methods are not applicable. W. J. Dick, in the March, 1913, *Bulletin,* of the Canadian Mining Institute, states that the determination of the presence of diamonds in place is difficult without recourse to petrographic methods. If it is suspected that diamonds are present in alluvial deposits, washing tests may be applied. In using these, it is well to remember that hornblende, pyroxene, garnets, sphene and tourmaline have approximately the same specific gravity as diamond. Three devices are in use for such washing tests in Brazil, the *bolinette,* the *barca* and the *batea.*

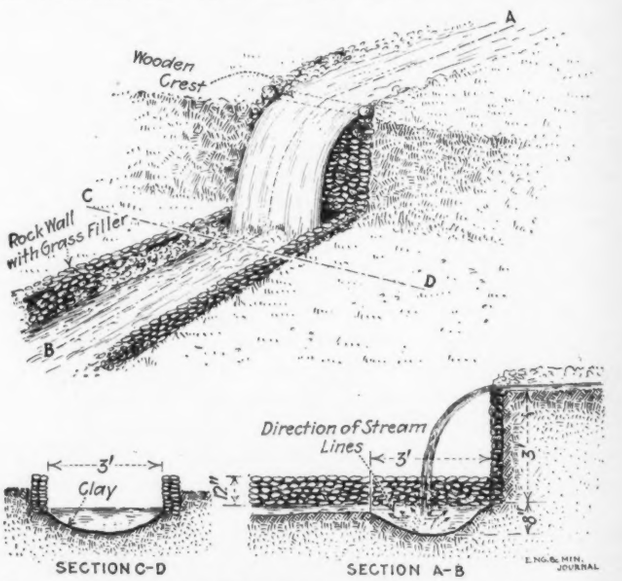


FIG. 1. BOLINETTE METHOD OF WASHING IN DIAMOND PROSPECTING

In the *bolinette* method, illustrated in Fig. 1, a stream of water is conducted so as to form a waterfall, about three feet in height. The fall is received in a saucer-shaped clay-lined pocket from which a sluiceway conveys away the discharged fine material. The material to be tested is dumped into the pocket under the fall after all large stones have been separated and cleaned. The washer standing in the sluiceway stirs the material continuously and breaks the lumps with a shovel or a wooden paddle, care being necessary not to injure the clay lining. The larger stones are picked out, from time to time, and the clay is washed away by the stream of water. When the pocket is filled, the concentrate and scrapings from the clay pocket are removed and reserved for further examination.

The *barca* is a rectangular box 4½ ft. wide by six feet long, set upon the edge of a body of water, as shown in Fig. 2, with one short side next the water, the board on that side being replaced with a series of wooden stakes in-

terlaced with grass so as to leave an opening about one foot wide at one side. At the upper end, inside the box, a clay-lined pocket is made similar to that of the *bolinette*. This should be about on a level with the water. Gravel is placed at the head of the box and is washed in the pockets as in the *bolinette* pocket. A stream of water is directed with a *batea* so as to fall about the center of the pocket at a steep angle. The action of the water forces the gravel forward and the rising current reflected from the pocket acts as a classifier. The fine sand is carried out as the water flows back and the washed gravel is occasionally scraped to the front of the *barca* where the largest stones are picked out and thrown away. When the pocket is filled with concentrate it is taken out as in the case of the *bolinette* and reserved. On the completion of the test, the bottom of the clay pocket is thoroughly scraped with a table knife to remove any diamonds that might possibly adhere.

The concentrate from either of these methods is next treated in a *batea*, which is a conical wooden or metal

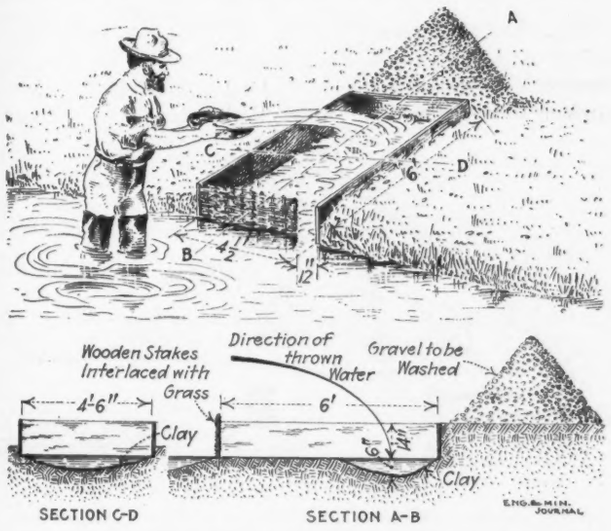


FIG. 2. TESTING FOR DIAMONDS WITH THE BARCA

dish 18 to 30 in. in diameter and four to six inches in depth. The material is washed as in a gold pan, but the heaviest particles are brought to a point instead of to an edge, and the waste material is scraped off by hand. The concentrate is placed in the *batea* with two or three handfuls of fine, clear sand. The washer standing in water to his knees, partially fills the *batea* with water, rotating it and stirring the material with one hand in a direction opposite to the rotation. The heavier particles are assisted in settling to the bottom of the cone and the fine sand settles through the spaces between the coarser pebbles and forms a layer between the pebbles and the concentrate, thus keeping the latter from rising to the surface. The coarser pebbles are picked out and discarded. When as much as possible of the waste rock has been removed and the *batea* is half filled with concentrate, the fine sand is removed easily by flowing over the edge as in gold panning.

The final examination may be conducted either by hand-jigging or by hand-picking. In hand-jigging a set of hoop screens of sizes, $\frac{1}{32}$ in., $\frac{1}{16}$ in., $\frac{1}{8}$ in., $\frac{1}{4}$ in. and $\frac{3}{8}$ in. is used. A small quantity of concentrate is jigged on the largest screen over a dish and that above $\frac{3}{8}$ in. is caught. After jigging for a time, the apparatus is quickly overturned and the contents deposited on a level surface. The top surface thus exposed is carefully examined with a knife. The same jigging process is applied to the remaining sizes. This method is rapid but somewhat difficult in the matter of overturning the screen, and, furthermore, does not necessarily show every part of the final concentrate. In the hand-picking method, a portion of the concentrate is placed in a *batea* and by spreading the material on the rim and lightly washing it into another basin, the observer may examine every particle. This process can be repeated as often as necessary. It is not difficult to recognize diamonds when wet as their luster is much greater than that of any other mineral with which they might be confounded.

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Transmission Line Poles and Towers

The steadily increasing use of electric power by mining companies and the fact that it is frequently generated in individual plants some distance from the mine or mill makes data on the construction of transmission lines of particular interest. In the *Engineering Magazine* for March, 1913, E. K. Lof, as part of a series of articles on "Hydro-electric Power," describes modern practice in transmission line poles and towers.

Wooden poles are usually used nowadays in connection with low-voltage systems, although they may occasionally be applied to high-voltage transmission purposes, especially in the West, where long and good poles can be readily obtained at reasonable prices. In one Southern system wood poles were used for an 88,000-volt line, 200 miles long. They are usually set 100 to 150 ft. apart and vary in length from 30 to 50 ft., an attempt being made to overcome somewhat the unequal grade of the ground. Spans up to 450 and 750 ft. with poles 85 ft. long exist, however. Reinforced concrete poles as a substitute for wood are now being adopted in some places.

Steel towers are the most important supports for high-tension transmission lines. They eliminate the danger of fire, and give a longer life. They permit higher supports, longer spans, fewer insulators and consequent less opportunity for breakdown. The sag for a given tension is in proportion to the square of the length of the span, however, and thus, the length of span is determined by the height of the support, and this height is limited by the fact that for increases in height, increases in lateral dimensions are also necessary. Conductors on high steel towers are usually stretched to a high tension, which means that they must be of high elastic limits and strung carefully with accurate observations as to temperature and pull.

The loads on a line are: Those acting in a horizontal direction parallel to the line, due to wire breakage; those acting in a vertical direction at right angles to the line, due to the weight of conductors, insulators and ice covering; and those acting in the horizontal direction at right angles to the line due to wind pressure. There is no pull along the line of the towers until a conductor breaks, in which case the stress which caused the break is thrown on the adjacent towers and must be allowed for. Towers are usually designed to withstand the breakage of only two conductors whether three or six conductors are used, and every tenth tower is made a "strain" tower, of heavier design to withstand the breakage of all

conductors. Suspended insulators somewhat reduce the stresses on conductors and towers as the length of the insulator is added to the length of the line when a break occurs, thus increasing the sag and reducing the tension.

Wind pressure is figured as acting on the projected area of two lateral surfaces of the tower and on the projected area of the wires for a length equal to one span. It is usual to assume an indicated wind velocity of 100 miles per hour with no ice covering and 80 miles per hour with ½-in. ice covering on the conductors. The indicated velocity corresponds to 62.2 and 76.2 miles per hour respectively of actual velocity. From the proper formulas it can be calculated that 23.2 lb. per sq.ft. on the towers, and 13 lb. per sq.ft. on the wires, projected area, is exerted by the wind of 100 miles per hour; while for the other conditions, assuming 85 miles per hour indicated velocity, the pressures are 17.2 and 10.8. The worst condition is assumed as existing in determining the design.

The so called flexible-tower construction is used in modern installations. Such structures are rigid to vertical and side pressures but capable of a slight movement in the direction of the line, consequently a wire breaking in one span would result in the shortening of the adjacent span until the tension on both sides became equal. This permits a lighter construction of towers, but the conductors must be strung with a higher factor of safety, as the stress is increased in case of a breakage. Flexible towers consist of a simple A-frame, of two uprights with cross braces. About every tenth tower is made a "dead-end" tower of the ordinary rigid construction, or else every fifth of the flexible towers is double-guyed.

For level country the height of steel towers varies from 50 to 75 ft., depending on the size of conductors, the sags and the length of the spans. The span varies from 300 to 750 ft., the first figure suitable for a No. 4 conductor and the latter for a No. 0000 up to a 300,000-circ.mils. cable.

For river crossings and similar conditions longer spans and special towers are installed. Towers 300 ft. in height supporting a 2000-ft. span are known, and the longest span yet erected is 4427 feet.

Substantial concrete foundations should be provided where the soil is loose or marshy, or where there is danger of floods. In hard and rock formations, such foundations are not necessary, but they afford good protection for the steel from rusting and may be justifiable. Where used, it is advisable to ground the towers by driving an iron pipe in the ground and connecting it to one tower leg.

Curves in Inclines

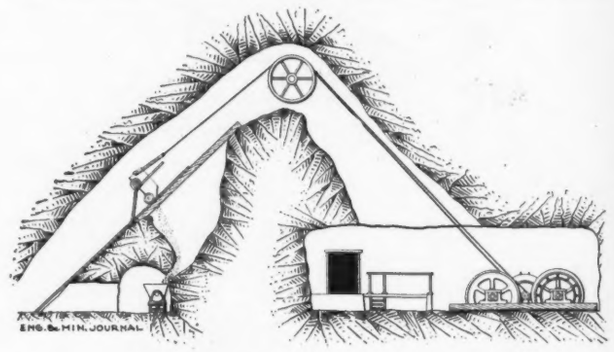
In sinking its No. 3 shaft to work the Kearsarge lode, in Michigan, the Ahmeek company, since it did not own the outcrop, was forced to start at the steep angle of 80°, and on approaching the lode to change the angle gradually by means of a vertical curve to the dip of the lode, about 35°. This vertical curve, as laid out, was about 450 ft. long, began with a spiral easement from the tangent which dipped 80° to a 14° 31′ curve, followed with a spiral from this curve to a 9° 10′ curve and finished again with a spiral to the 35° tangent of the lode. Overhead rollers were necessary, of course, to keep the rope from the back.

In the inclined Centennial shaft No. 2, there is a lateral curve. This was necessary to enable the shaft to serve the deeper portions of the property. The principal curve has a radius of about 1090 ft. and a delta of 11° 39′ 14″. At the bottom end, a reversed curve is applied with the same radius and a delta of 2° 19′ 10″.

The object of this reverse curve was to bring the bottom side-roller opposite the center of the tangent track in order to get the rope to follow the rollers. Four sets of side rollers are necessary. At the top of the curve no reverse was put in and some difficulty is experienced with the rope getting off the rollers. The outer rails are, of course, raised on the curve. A reduction of one-third in the normal hoisting speed is necessary on the curved portion of the incline, but this slower speed is 1700 ft. per min. The arrangement has proved satisfactory in practice.

Underground Hoisting Arrangement

The accompanying drawing is a longitudinal section of an underground hoisting station for an incline shaft in the New Heriot mine on the Rand, described by A. W. Brown in the November, 1912, *Transactions* of the North



LAYOUT OF UNDERGROUND HOIST AT NEW HERIOT MINE

of England Institute of Mining and Mechanical Engineers. A similar installation was designed for the Santa Eduviges mine of the Sierra Mining Co. in Ocampo, Chihuahua, and in the JOURNAL for Apr. 29, 1911, p. 848, there is a description of an equivalent layout for a vertical underground shaft with the rock bin beyond the shaft. The arrangement is self-explanatory and its advantages are evident; for the given height, at which it is necessary to set the sheaves to get dump room, the minimum of rock excavation is attained. The construction of rapidly deteriorating wooden bins and headframe is avoided and a rigid and massive setting obtained for sheaves and dumping device.

The installation of such a system is a nice little job for the surveyor in lining up sheaves and drums with the shaft.

A Saccharine Solution for Preserving Timber is made use of in the so called Powell process in England, according to the "Canadian Engineer," Jan. 9, 1913. The timbers are treated by the usual open-tank method, using a hot solution, and then dried artificially in a special chamber. In heating, the saccharine takes the place of air and moisture driven from the timber and coagulates with albuminous matter in the wood. It is thoroughly assimilated and is invisible either as crystals or syrup. The wood is said to be hardened as well as preserved. The Powell Wood Process Syndicate, Ltd., 718 Salisbury House, London Wall, London, E. C., holds the patent rights.

DETAILS OF METALLURGICAL PRACTICE

Recovering Brass from Foundry Cinders

By Lucius L. Wittich*

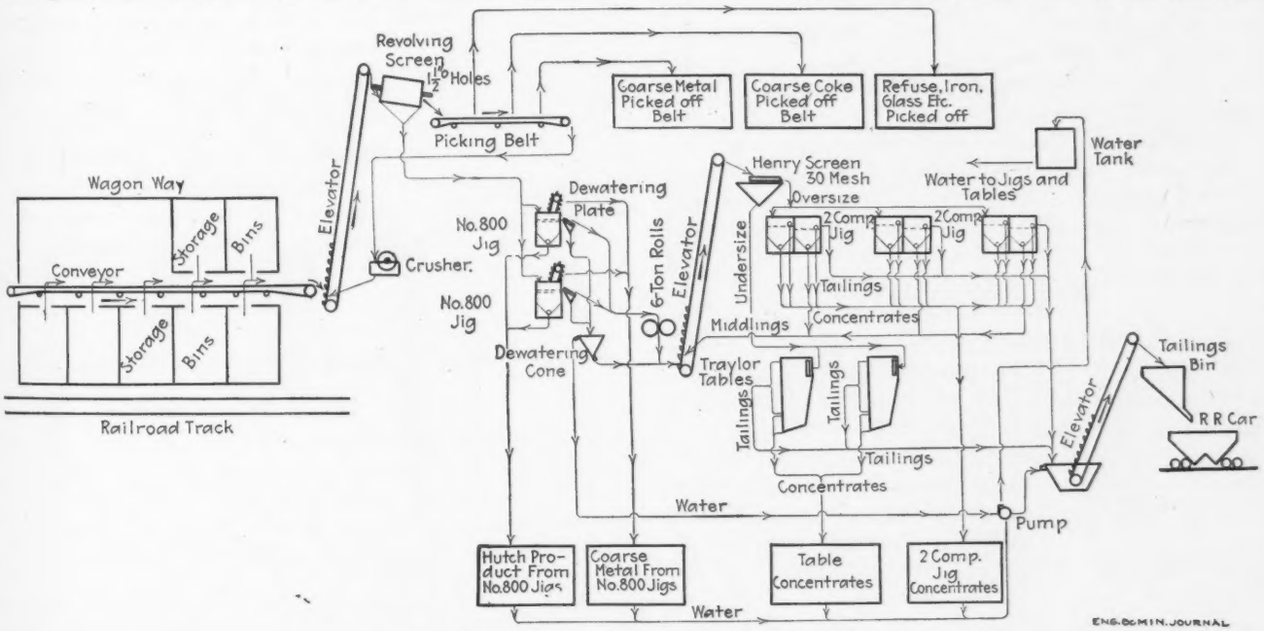
The accompanying flowsheet shows the process of reclaiming brass contained in the cinders from brass foundries. The plant, the largest of the kind, is being installed by the Michigan Smelting & Refining Co., of Detroit. It is being constructed by the American Concentrator Co., and is similar to, but more elaborate than other smaller plants recently installed. In these smaller plants the reclamation of brass particles, heretofore almost completely lost, has proved satisfactory. There are three such plants at Bridgeport, Conn., one at Boston, one at Erie, Penn., two at Philadelphia, one at Cleveland, one at Cincinnati, one at St. Louis, one at Chicago, besides the large plant at Detroit.

Heretofore the Michigan Smelting & Refining Co. has disposed of its brass-bearing cinders to junkmen who would hand-pick them, thus recovering a small percentage of the metal contained, who would, in turn, resell the recovered product to the foundries for resmelting. With the installation of the reclaiming plant the smelting company will not only treat all its own waste, but will purchase a similar product from other brass foundries in adjacent territory. The storage bins will be so arranged that cinders from railway cars may be unloaded on one side, while wagons may unload on the other.

The plant will have a capacity of 75 tons daily. The original feed will carry from 3 to 5% of metal. The concentrates will carry from 25 to 50% metal. The loss of metal in the tailings, it is estimated from operations at other plants, will be less than ½%. The metal recovery should be close to 7000 lb. daily when the plant is operated at full capacity.

Beneath the receiving bins a conveyor belt, automatically fed, carries the cinders to an elevator, and thence to a revolving trommel. The oversize from the screen, which is 1½-in. mesh, goes to a hand-picking belt, which is 36 in. wide and which revolves slowly. The coarse, heavy cinders passing over the end of the belt go to a 15-in. Blake crusher, and thence return to the 1½-in. trommel.

The heavy, coarse metal picked off the belt goes to a bin, and is ready for the crucible. The coarse coke goes to a bin and can be used in smelting. The refuse goes to the dump.



Plant for Recovering Brass from Cinders

Undersize from the 1½-in. trommel goes to a pair of bull jigs, each of single compartment, 36x48 in., operated by double eccentrics, at 75 r.p.m. The hutch product from the two bull jigs carries from 25 to 30% brass and goes to a bin, ready for the crucible. A rotating valve at end of jigs gets the coarse metal. All tailings from the bull jigs are reground. They first pass over dewatering plates, the dry tailing passing to a set of rolls, and the water going to a dewatering cone. Both the reground tailings and the sediment from the cone pass to an elevator, thence to a 30-mesh Henry shaker screen. The oversize goes to three sets of two-compartment fast-motion jigs, each compartment being 24x36 ft. Double eccentrics have 175 r.p.m. The undersize passes to hopper, hence to two Traylor tables.

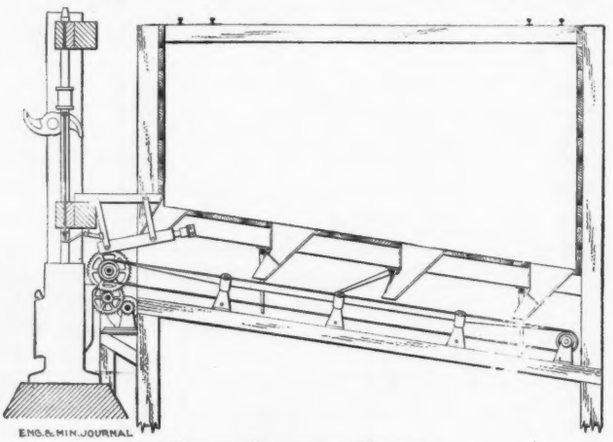
Tailings from the three fast-motion jigs and from the

*Joplin, Mo.

tables pass through launders to a hopper, are elevated, and stored in a bin, ready for removal in railway cars to be used as ballast or for other purposes. Middlings from the fast-motion jigs return to the elevator and are retreated, after passing through a set of baby rolls which are not shown on the flowsheet, this change having been decided on after the first plans were drawn.

Behr Battery Feeder

H. C. Behr, of Johannesburg, has patented (U. S. pat. 1,047,396) an automatic feeder for stamp batteries. As shown by the illustration, the ore from the bin is supplied to the battery by both a conveyor belt and a shaking feeder of the bumper type. The conveyor belt, as the primary feeder, maintains a constant supply of ore



BEHR BATTERY FEEDER

to the battery at slightly under its normal capacity. Any deficit is made up by the shaking feeder which is actuated by the impact of the tappet of one of the falling stamps upon a rod. The length of this rod is so regulated that the tappet will not reach it except when the drop of the stamp is longer than normal, owing to an under supply of ore in the battery; when the deficiency has been made good the drop of the stamp is shortened sufficiently so that the auxiliary feeder will cease to work.

Boiler Capacity and Efficiency

The problem in practical boiler operation is to secure capacity and efficiency simultaneously. It is well known that the CO_2 content in the products of combustion in the stack is a reasonably good index to combustion efficiency but absolutely no guide to the capacity being developed. Hence, when CO_2 alone is depended upon, says *Power,* Feb. 11, 1913, it is often found that when high CO_2 has been attained, the rate of steam output has fallen off and, to restore the proper rate quickly, it is necessary to sacrifice economy.

Most economical results are secured with a white fire and evenly covered grate, conditions conducive to high CO_2. It is difficult for even a well experienced fireman to know simply by observation when these conditions prevail to a maximum extent. And even if good combustion conditions do prevail, it is especially difficult to be certain that the boiler is developing its proper load.

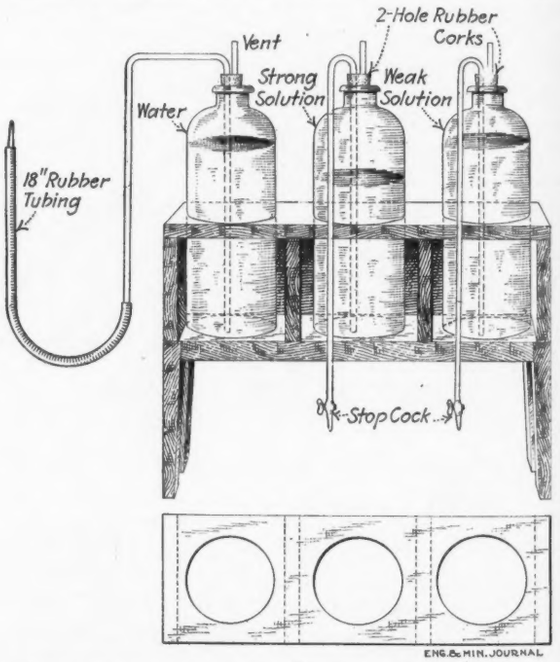
With the boiler operating at its normal rate (that is to say, with a fixed total effective draft) a decrease in the normal resistance of the fire produces an increase in the drop in draft through the boiler and a loss in efficiency due to excess air. An increase in the resistance of the fire causes a decrease in the drop through the boiler and a reduced rate of steaming; if the increase is extreme there is also an efficiency loss due to incomplete combustion.

Siphons for Parting Acids

BY J. D. VARIAN*

A convenient arrangement for dispensing acids and wash water in parting gold-silver buttons can be made from three ordinary discharged acid bottles and a few lengths of glass tubing for siphons.

Two lengths of glass tubing 36 in. long with stop-cocks at one end and one length of 36 in. with no stop-cock are required. The tubing should be $\frac{3}{16}$ in. inside diameter, and below the stop-cock should be drawn out to about $\frac{1}{16}$ in. inside diameter. An 18-in. length of rubber tubing is attached to the wash-water siphon to facili-



ARRANGEMENT OF ACID SIPHONS FOR PARTING

tate running the water into a number of parting capsules. This rubber tubing should be fitted on the end with a short piece of glass tubing drawn down to $\frac{1}{16}$ in. inside diameter. The water may be shut off with a pinch-cock.

The bottles are placed on a shelf at a convenient height above the laboratory bench. At one third the height of the bottles a board with large holes in it is placed to hold the bottles in place. The accompanying sketch shows all details.

Sugar and Concrete Seem to Be Antipathetic—Charles A. Newhall ("Eng. News," Mar. 6, 1913), states that in several instances failure to set on the part of concrete, and disintegration after setting have been traced to the effect of minute quantities of sugar mixed with the cement. It is stated that ¼% will completely kill the set, and it is suggested that the effect of so small a quantity on so large a bulk of material can be the result only of catalytic action.

*Assayer, Tomboy Gold Mines Co., Ltd., Smuggler, Colo.

NOTES FROM CURRENT LITERATURE

Reduction of Rare Metals by Calcium

The preparation of zirconium by alumino-thermic methods or by magnesium, was not found satisfactory by E. Wedekind (*Annalen*, p. 149, 1913; abstr. *Journ.* Soc. Chem. Ind., p. 197, 1913), who gives the following as applicable not only to zirconium, but also to titanium, thorium, tantalum and allied metals. Pure zirconium oxide was intimately mixed with an excess of metallic calcium (as finely divided as possible). The mixture was placed in an iron tube which was exhausted to about 0.5 to 0.1 mm. The bottom of the tube was heated with a blow-pipe till the reduction began, after which the tube was cooled by blowing air on it and finally dipping in water. When quite cool, the contents were rapidly pulverized and treated first with water which had been boiled and then cooled, next with acetic acid and finally with very dilute hydrochloric acid. Air should be excluded during the whole of the treatment. The residue was finely powdered and again digested with boiled dilute hydrochloric acid. The powder was filtered off, and washed with air-free water till the calcium reaction (spectroscopic) was no longer given. The water was removed by acetone and the powder dried in an exsiccator at ordinary temperature and then in a high vacuum at 250 to 300° Centigrade.

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Concentration of Ores out of Country Rock

The relative solubilities of the important oxides entering into rock composition is discussed by C. H. Smyth, Jr., in the *Journ. of Geol.* Vol. XXI, No. 2. Calculations are made, based on Clark's figures for the dissolved material in the river waters of the earth, together with an estimate of the composition of the surface rocks of the earth, obtained by combining, in the ratio of 3 to 1, estimates on the sedimentary rock composition, and on the igneous rock composition of the earth crust; this being based on the supposition that the surface of the earth, which is subject to solution by atmospheric waters, is composed of sedimentary rock in that proportion. The various oxides are considered, irrespective of their combination, no attention being paid to minerals. The percentage of each oxide in the dissolved material in the water is divided by its percentage in the rock, obtaining a relative solubility, which is recalculated on the basis of 100 for the solubility of lime. The solubilities of other oxides are as follows: Soda, 96.1; magnesia, 36.3; potash, 11.9; silica, 3.7; iron and alumina sesquioxides, 2.6. This represents probably the average relative solubilities, qualitatively at least, if not quantitatively.

When the same method is applied to specific rivers and their adjacent country, discordant results are obtained. However, this discordance seems to result in a certain general law which is: As the percentage of an oxide in a rock formation decreases, its relative solubility increases. For instance, in one case where the percentage of magnesia in the rock was low, its relative solubility rose to 244, as against the 36.3 just noted. This is offered as an explanation of the concentration into workable orebodies of minute quantities of disseminated metals.

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Drawn Tungsten Filaments

At the March meeting of the Institute of Metals, Alexander Siemens read a paper on the durable metal-filament lamp. Among other things, he stated that the tungsten was prepared from the ore as yellow oxide, which was reduced, the metal being obtained as powder. By heavy pressure this powder is made into rods, which are so fragile they must be left on their support during the next operation (*Engineering*, Mar. 14, 1913). This consists in heating them in an atmosphere of hydrogen, and the rods are then swaged. This swaging is light, in fact the rods must barely be touched. They are then heated again in hydrogen, and an electric current is passed simultaneously, after which they are somewhat stronger. After repeated swagings and heatings, the metal becomes ductile, the metal is rolled, and the rolled bars are drawn into wire. No annealing is required between drawings, although annealing is often performed, as it saves wear on the dies.

The strength manifested by small wires was extraordinary. A wire of 0.1 mm. diameter had a strength of 180 tons per sq.in., while one of 0.0167 mm. in diameter showed 380 tons per sq.in. The size of the wire was deduced from its weight. The metal in these wires contained no carbon, as it was reduced from pure W_2O_3, and the greatest care was taken to prevent subsequent contact with carbon. If any carbon was present in the metal, the powder would not adhere under pressure.

⁂

Chemical Extraction of Tin from Ore

While awaiting further returns from Arthur Richards' volatilization process, Henry Bailey's neutralization of tin containing colloids, or Mr. Gee's centrifugal separation, it is well to know that these do not exhaust the inventors' projects, but that another process has been evolved which appears worthy of further investigation, says the *Mining Journal*, Mar. 22, 1913. It not only recovers 98% of tin contents as pure tin oxide, but also recovers any copper or iron contents as copper precipitate or oxide of iron respectively. James W. Chenhall, who has devoted 42 years to metallurgical pursuits, for the last two or three years has been interesting himself in working out a chemical method for the extraction of the tin contents of an ore. His process necessitates three operations: Roasting, leaching and precipitation. The ore (which has previously been reduced to the ordinary mesh coming from a battery), to which has been added a certain proportion of carbonaceous matter, is roasted in an inclosed

furnace heated to about 1200° F., the resulting gases being passed and repassed through the mass until all the oxygen has been absorbed. The resulting porous mass is now thoroughly leached in an air-tight receptacle by means of a solution which dissolves the tin, iron or copper present.

These three products are afterward precipitated individually from this solution, the tin coming down as pure tin oxide, the copper as copper precipitate, and the iron as a sulphate or oxide of iron. Mr. Chenhall states that the entire cost of the treatment will be more than met by the value of the byproduct, and it is understood that certain managers have sent, or are sending, their ore for treatment in Mr. Chenhall's experimental plant at Totnes, where it will be dealt with under their own supervision. The effect of this treatment on those ores containing wolfram, of which several of the mines have considerable quantities disseminated more or less throughout, is somewhat anxiously looked for, and arrangements are, I am given to understand, being made for an early test of this class of ore. If the wolfram remains in the residue as a product amenable to the influence of the magnetic separator its final recovery may readily be assured, or possibly some chemical means may be evolved for securing the tungstic acid (WO_3) direct.

Diphenylcarbazide as a Bichromate Indicator

The use of diphenylcarbazide as an indicator in bichromate iron determinations is urged by O. L. Barnebey and S. R. Wilson (*Journ.* Am. Chem. Soc., p. 156, 1913). A solution of the indicator containing 0.1 gram per liter is used. After solution of the ore and reduction by stannous chloride in the usual manner, the volume is made up to 500 to 600 c.c., mercuric-chloride solution is added, then 20 c.c. of manganese-sulphate solution (200 grams of sulphate, 1100 c.c. of 1:3 sulphuric acid, and 100 c.c. of phosphoric acid of sp.gr. 1.70 made up to 2 liters), and 2 to 3 c.c. of the indicator. The first drops of bichromate strike a deep-red color, which changes to purple and gradually fades, changing sharply at the end into the pure green of the chromic salt. A blank experiment with the indicator and ferric chloride must be made, as the indicator is itself a reducing agent and uses up bichromate in proportion to its quantity.

Phonolith in Iceland

The representative of a German company has arrived at Reykjavik, in Iceland, with the intention of examining the lava of which the greater part of the soil of the island is formed with a view to ascertaining whether it is possible to extract phonolith therefrom, for use as potash fertilizer, says the *Chemical Trade Journal,* Mar. 22, 1913. Several samples of soil taken near Hafnofjord in the Reykjavik district have proved good, and the company has made application for a concession to work this portion of the island. It is intended to erect works capable of turning out 900 tons of phonolith per week, and affording occupation for 200 workers. It does not yet seem quite certain that the lava contains sufficient quantities of the material to make the enterprise a paying one, but this will shortly be settled when the report of the analyst is received. Should the Icelandic lava possess the required strength, the new industry will prove a most important one for the island.

New Copper Producer in German South-West Africa

The Otavi mine is no longer the only producing mine in German South-West Africa. According to the *Mining Journal,* Mar. 15, 1913, the Khan copper mine, on the Khan River, has entered the producing stage after having been opened to a depth of 160 m. The result of the development work is stated to have been encouraging. The visible ore reserve guarantees considerable working profits and a long life. An uptodate reduction plant is being erected, to treat 50 tons of ore per day, which is expected to start work early in 1914. The water required for the works is pumped up from the Khan River through a pipeline of a length of 18 km. Electric power will be generated at a central station. The works are connected by private line with the railway at Arundis.

Ardlethan Tin Field in New South Wales

The Ardlethan tin field, recently discovered, has been attracting considerable attention in Australia. As described by W. C. Walworth Pearce in the *Australian Mining Standard,* Mar. 6, 1913, tin undoubtedly exists there and a good field may be developed, but reports have been highly exaggerated. The mineral is cassiterite, and occurs in granite, associated usually with tourmaline. Most of the prospects show small deposits in the nature of pipes. The water supply is something of a problem. The field is about 337 miles by rail from Sydney on the Temora-Barellan branch line. The methods of prospecting are poor, most of the work being done by those unacquainted with the mineral. The richest ore is sent to Sydney, but the greater part goes to Wyalong, where it is dressed in rather a crude plant.

Gold in the Austrian Alps

A discovery of a rich auriferous quartz deposit has been made in the course of some excavation for road-making purposes near Zell in the Ziller Valley, Tyrol (*Min. Journ.,* Feb. 15, 1913). The gold occurs in visible coarse grains. Samples stated to represent average ore have been analyzed by independent assayers and found to contain 115 grams per ton. From a parcel of 5.338 tons of ore, treated in the course of regular work by a Rhenanian reduction works, 827.39 grams of fine gold were recovered, equal to 155 grams per ton. Importance is attached to this discovery, because it confirms the reports of an ancient, extensive and profitable gold-mining industry in the Ziller Valley, and is likely to give a fresh impetus to gold mining in Austria. Since 1902, when an English company retarded operations at Rouday, Austria's gold production has increased from 7 kg. to 205 kg. per annum. Near Böckstein, in the Hohe Tauern, the Hathausberg company is now engaged with uptodate machinery in extensive development work. In the Hohe Tauern, as well as in the Ziller Valley, the general conditions are favorable to mining.

Determination of Nickel and Cobalt

By R. L. Hallett*

SYNOPSIS—A method for the determination of nickel and cobalt, based on the well known dimethylglyoxime and nitroso-β-naphthol reactions.

The precipitation of nickel with dimethylglyoxime and of cobalt with nitroso-β-naphthol are both well known reactions and their accuracy has been so well established that they need little comment.[1] I had never known of these reactions being used together in a commercial method for the determination of nickel and cobalt, but recently I developed a method along these lines which is satisfactory, accurate and rapid. I have found it better than any other method I have used for the determination of these metals, and it is particularly useful for the determination of small amounts of either metal in the presence of large amounts of the other.

Nickel can be precipitated with dimethylglyoxime—$CH_3C(NOH)C(NOH)CH_3$—either in faintly ammoniacal solution or in one faintly acid with acetic acid. In most cases it is better to do it in ammoniacal solution and that is the method generally followed, but when there is only a small amount of nickel present and a large amount of cobalt, it is more satisfactory to precipitate the nickel in acetic-acid solution. In either, the precipitation of the nickel is complete and can be performed in the presence of cobalt, zinc and the members of the alkali and alkaline-earth groups. All other metals are first removed and the nickel and cobalt are brought into hydrochloric-acid solution.

Cobalt can be precipitated with nitroso-β-naphthol—$C_{10}H_6(NO)OH$—in hydrochloric-acid solution. Copper and iron are also precipitated under these conditions, silver, tin and bismuth are partially precipitated, and lead, mercury, arsenic, antimony, cadmium, aluminum, chromium, manganese, nickel, zinc, calcium, magnesium and glucinum remain in solution. We, therefore, separate the interfering elements and finally bring the cobalt into hydrochloric-acid solution.

Decomposition of the Ore

Most substances containing nickel and cobalt will decompose when treated with nitric acid and potassium chlorate. Treat one-half to one gram (depending on the amount of nickel and cobalt present) of the finely divided sample in a 6-oz flask with 10 c.c. of nitric acid (sp.gr. 1.42). Boil until half gone, add 5 grams of potassium chlorate and 5 c.c. nitric acid and evaporate to complete dryness, avoiding overheating. Cool, add 35 c.c. ammonia (sp.gr. 0.90) and warm gently until the entire mass is disintegrated. Add 15 c.c. saturated bromine water and heat a few minutes longer to precipitate any manganese. Filter and wash with hot water. Rinse the residue on the paper back into the flask, place the flask under the funnel and pour a little hot (1:2) hydrochloric acid through the filter. Wash with hot water and boil to dissolve completely all soluble residue. If any insoluble matter remains (other than clean silica, etc.), which might contain nickel or cobalt, filter through the same paper, wash, ignite and either again treat with nitric acid and potassium chlorate, evaporate to dryness and take up with hydrochloric acid, or fuse with mixed sodium and potassium carbonates and take up with hydrochloric acid. In either case the hydrochloric-acid solution is added to the original filtrate. This treatment of the residue is hardly ever necessary. In case the material under consideration is not decomposed by any of the above treatments other standard methods must be used to get the nickel and cobalt into hydrochloric-acid solution.

The solution in the flask is diluted somewhat, 15 c.c. saturated bromine water are added, and then ammonia in excess. Boil for a short time, filter and wash with hot water. Unite the two filtrates which now contain all the nickel and cobalt. If considered desirable the iron precipitate may again be dissolved and a basic-acetate separation made, the filtrate to this being evaporated and added to the other filtrates. This will not be found necessary, however, in technical work.

Precipitation of the Nickel

Acidify the combined filtrates with hydrochloric acid, adding 5 c.c. in excess and boil for a few minutes to decompose chlorates. Dilute to 250 c.c. with hot water and saturate with hydrogen sulphide. Filter off the sulphides and wash with dilute hydrogen-sulphide water. Boil off the hydrogen sulphide. Be sure there is enough ammonium chloride present to prevent the precipitation of zinc as hydroxide when the solution is made ammoniacal, and to the boiling hot solution add an excess of 1% alcoholic (ethyl) solution of dimethylglyoxime. Make just ammoniacal and a red precipitate will at once settle out. Add more ammonia if necessary to neutralize the hydrochloric acid set free in the reaction. Let stand one-half hour, filter on a weighed gooch crucible, wash with hot water, dry for one hour at 110° C., and weigh as $NiC_8H_{14}N_4O_4$, which, multiplied by 0.203, gives the weight of the nickel.

In case there is only a little nickel and much cobalt present neutralize the hydrochloric-acid solution with potassium hydrate, make just acid with hydrochloric acid, heat to boiling, add the dimethylglyoxime and then add sodium acetate until the red precipitate forms or, in case no nickel is present, until all the free hydrochloric acid is neutralized. Add one gram sodium acetate in excess, let stand one-half hour and then filter and weigh as usual.

Catch the filtrate from the nickel in an 8-oz. flask and add sulphuric acid (sp.gr. 1.84) until strongly acid. Evaporate over a free flame to dense white fumes of sulphuric acid. This treatment will destroy all organic matter. Cool, add 30 c.c. water, 5 c.c. hydrochloric acid and heat until all is in solution.

Precipitation of the Cobalt

Transfer to a beaker, maintain at 50° C. and add freshly prepared hot solution of nitroso-β-naphthol in 50% acetic acid as long as a precipitate is produced. Allow to settle and then test with more reagent to see if precipitation is complete. Precipitate consists of

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[1] G. Lunge, "Chemisch-technische Untersuchungs Methoden," Vol. 2, p. 332; O. Brunck, "Zeit. f. angew. Chemie," Vol. 20, p. 1844; Prescott & Johnson, "Qualitative Analysis," p. 166; A. H. Low, "Technical Methods of Ore Analysis," p. 169.

$Co(C_{10}H_6O(NO))_3$, together with considerable of the reagent. Let stand for one hour at 50° C. Filter and wash with cold and then with hot 12% hydrochloric acid and finally with hot water. Ignite in a platinum crucible and weigh as Co_3O_4, which, multiplied by 0.7344, gives the weight of the cobalt. It may seem dangerous to ignite the cobalt salt in a platinum dish, and if desired, porcelain can be used, but I have done it many times in platinum and have never had it alloy with the dish.

If preferred the dried cobalt precipitate may be placed in a weighed Rose crucible and ignited, gently at first, and then with the full power of the bunsen burner. When the filter paper is all consumed the cobalt is reduced to metal by heating in a current of hydrogen, cooled and weighed.

The principal objection to this method is the cost of the reagents. Nickel requires five parts of dimethylglyoxime to precipitate it and some excess must be used. Cobalt forms a soluble compound with dimethylglyoxime, as does zinc, so enough must be added to react with these metals as well as with the nickel. Dimethylglyoxime is now selling for $1.55 per oz., which, of course, is quite expensive, and the only way to keep down the cost is to start with proportionately small samples. If this is done the cost of a single analysis should not be more than 8c. to 10c. The precipitation is so accurate that reliable results are possible when starting with small samples. Moreover, the dimethylglyoxime can be recovered with ease from the collected precipitate. This is accomplished by shaking with water, pouring the crystals into a dish and warming with potassium cyanide until all has gone into solution with a reddish-yellow color. The hot solution is filtered quickly, if necessary, through a folded filter and made acid with acetic acid, whereupon the oxime is separated as a white crystaline precipitate which is usually pure enough for further use and is filtered and dried. If it is colored red it can be recrystallized from hot alcohol after decolorizing with animal charcoal, according to O. Brunck.

It has been suggested that the alcohol used would be expensive, but if care is taken not to use a great excess of the reagent or a sample containing an excessive amount of nickel the cost of the alcohol used will not be at all exorbitant. Nitroso-β-naphthol costs about 65c. per oz. at the present time, so it may be considered within the limits of desired economy.

Of course, it will readily be seen that this method costs more than most of the others, and the cost might be a consideration when there are a large number of determinations to be made and where accuracy is not of the greatest importance, but generally speaking, the time saved and the accuracy attained will more than make up for the cost of reagents. I have tested this method, starting with varying amounts of pure nickel and cobalt in the presence of large amounts of zinc, calcium, magnesium and alkalies and have found it extremely accurate and satisfactory.

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About 400 hp. Will Be Consumed in the Bearings of a turbine built by C. A. Parsons & Co., for the Commonwealth Station in Chicago, according to "Power," Mar. 25, 1913. This seems a large consumption, but it is only about 1½% of the capacity of the unit, which is a 20,000-kw. machine. The heat produced is that equivalent to burning 80 lb. of coal per hour. The ability to dissipate this heat reveals the advances made in modern bearing construction. The oil of the lubricating system is circulated through a cooler, and not only acts as a lubricant, but helps to remove the generated heat.

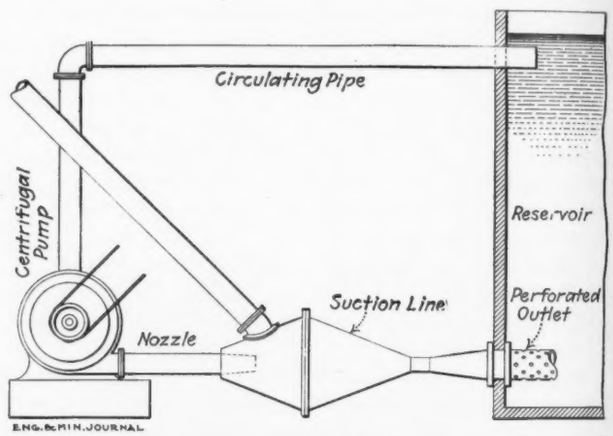
Heslewood Scrubber

A device for scrubbing flue gases is illustrated in a patent issued to William R. Heslewood, of Berkeley, Calif. (U. S. pat. 1,052,144, assigned to the South Fork Smelting Co.). The scrubbing is done by water traversing a closed cycle, impelled by a centrifugal pump. As shown in the illustration, the centrifugal pump delivers the water through a nozzle into a gas case made of two reducers, bolted together at their large ends.

The water then goes from the second reducer into an expanding nozzle, which finally delivers it into a tank through a pipe pierced with a multiplicity of holes. The centrifugal pump then draws its feed from the same tank. There is a suction produced in the gas case by the jet of water, and the flue gases are thereby drawn in, scrubbed and discharged through the holes in the exit pipe.

Whether the emulsion produced by any large quantity of insoluble flue dust might not clog the pump and exit holes would require experiment to determine, but the apparatus would certainly seem to have some use for scrubbing out soluble liquids or solids, as SeO_2 or SO_3.

This forms part of a patent covering a shaft furnace, in which the entire blast is to be produced by this scrubbing arrangement and the natural tendency of hot gases to rise. The heat of the exhaust gases is to be used in generating steam and preheating the blast. The whole patent is not reproduced, as it seemed somewhat questionable whether blast produced by this means would penetrate any great depth of charge.



HESLEWOOD GAS SCRUBBER

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Steel Production in Austria-Hungary

The production of steel and wrought iron in Austria-Hungary for the year 1912 is reported as follows, in metric tons:

	Austria	Hungary	Bosnia	Total
Acid converter	975	51,870	.....	52,845
Basic converter	347,100	.....	.....	347,100
Openhearth	1,497,206	725,350	38,583	2,261,139
Puddled and crucible	39,548	2,006	.....	41,554
Electric	19,891	1,665	.....	21,556
Total steel	1,904,720	780,891	38,583	2,724,194
Wrought iron	48,494	12,417	.....	60,911

Openhearth steel was 83% of the total. The acid converter is used to a considerable extent in Hungary, but hardly at all in Austria; on the other hand the basic converter finds no place in the Hungarian industry.

Montana-Tonopah Mines Co.

The report of the Montana-Tonopah Mines Co. for the year ended Aug. 31, 1912, shows that the 53,874 tons of ore mined and milled had a gross value of $826,524, or $15.34 per ton. The amount of ore produced is 1782 tons greater, and the average value 78c. per ton higher than that of the preceding year.

Development work amounted to 10,076 ft., divided as follows: Drifting, 2769 ft.; crosscutting, 5356 ft.; raising, 1669 ft.; sinking, 282 ft. In addition to this, three diamond-drill holes were completed, a total of 1048 ft. being drilled. These drill holes, two of which were started in 1911, were sunk from the 765-ft. level in the northern part of the property. The greater part of the development was confined to the southeastern portion of the property, and resulted in the discovery of several bodies of good ore. The total costs of development were $1.35 per ton, which is a reduction of 20c. per ton over the previous year. Of the total ore hoisted during the year, 4811 tons were produced from development. In addition to 18,875 tons of waste hoisted, a large proportion of the amount broken was used as filling in some of the stopes.

The most important development made during the year is that of the Shaft vein, which produced a large tonnage of good ore. On account of the broken and faulted condition of the orebodies, a large amount of unnecessary expense would be entailed to delimit them. Therefore, no attempt was made to block out the ore with a view to measuring the tonnage exposed. It is estimated, however, that there are 32,000 tons of ore available in the mine.

The mill was operated continuously for 342 days and maintained a stamp duty of 3.93 tons. The figure of extraction are as follows: By concentration, 33.3%; by cyanidation, 56.7%; total extraction, 90%. Two underfeed Trent agitators were installed, and for the latter part of the year the shipment of practically all vanner concentrate was discontinued, it now being treated direct with the mill product, thus saving the shipping and smelter charges. B. A. Bosqui, mill superintendent, states that the economic balance between loss in extraction and saving on concentration is still on the side of decreased concentration. He expects that during the coming year the cyanide plant will absorb the extra concentrate without suffering in extraction, and a material saving will be effected. A reduction in milling costs of 13c. over the previous year is due principally to increased power and water efficiency, and the small saving in concentration. The costs are given as follows: Mining and development, $4.40; milling, $2.96; general, $0.63; marketing, $0.78; total, $8.77 per ton of ore milled.

The company's holdings were increased during the fiscal year by the acquisition of 1,111,666 shares of stock, representing a controlling interest in the Commonwealth Mining & Milling Co., of Pearce, Ariz., for which $191,392 was paid. This sum includes cost of examinations and other expenses incident to the purchase. Since the close of the fiscal year, 38,320 shares of the Commonwealth stock have been acquired at a cost of $4152. It is stated that the entire issue of $250,000 of the Commonwealth bonds has been placed, thus enabling the Commonwealth company to build a 350-ton mill, and the contracts for a large portion of the machinery were closed in December. The excavation and concrete work were under way in December. It is believed that six months will be required for the building of the mill.

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Karns Tunneling Machine

The Karns tunneling machine is described by O. J. Grimes, in *Engineering News*, Mar. 6, 1913, who cites as evidence of its practicability, the driving of a 100-ft. tunnel in granite near Boulder, Colo., and a 200-ft. tunnel for the Valley Coal & Stone Co., near Johnstown, Penn., of which several views are shown. The motion of the machine in operation is similar to that of the small air drill, the blows being delivered by direct forward motion. On the back stroke, the reciprocating parts turn slightly by means of a rotating device, similar to the rifle nut in the small drill, so that with each succeeding blow the cutting points strike the rock at a different place. The rock, instead of being ground into dust, falls down in small chips. The latest and largest machine constructed has a cutting head 6 ft. in diameter, shown in Fig. 1.

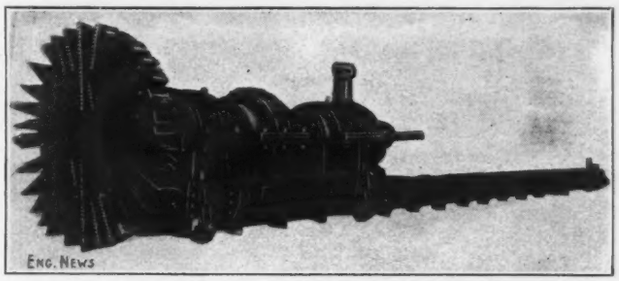


FIG. 1. KARNS TUNNELING MACHINE, SHOWING CUTTING HEAD 6 FT. IN DIAMETER

There are 41 cutter blades made of tool steel, each one inch thick, five inches wide and of various lengths. Points like saw teeth are machined on one edge and the other edge is fastened in the face of the head. The entire set of cutters may be removed and replaced in about 2 hr. One set, it is said, will drive from 25 to 75 ft. of tunnel, depending on the hardness of the rock.

FIG. 2. A 6-FT. DIAMETER TUNNEL DRIVEN WITH THE KARNS MACHINE

The reciprocating parts of this machine weigh 7¼ tons

and make about 140 strokes a minute, of seven in. each. The claim is made that the machine will cut two to four feet of tunnel per hour.

The cylinders are inclosed in a shell and connected to the supporting parts of the operating machine by heavy rods. The shell supporting the cylinders is held firmly in place by four columns, seen in Fig. 3, two in front and two in the rear, jacked to the top and bottom of the tunnel. The columns, shell and machine are advanced simultaneously with each six feet of tunnel driven.

In the front cap of the machine are the front bearings, consisting of 48 steel balls three inches in diameter, resting in 12 straight grooves, planed on the outside of the hub

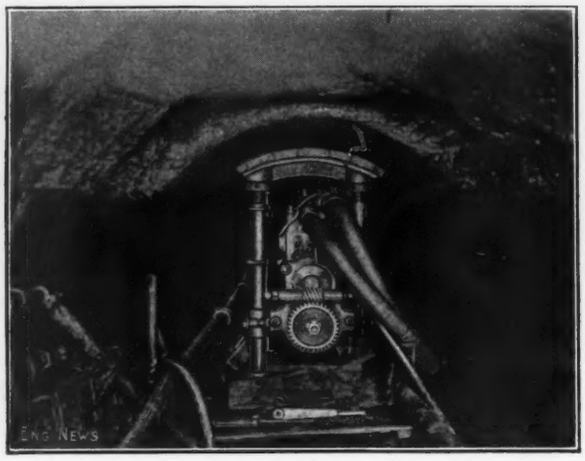


FIG. 3. REAR VIEW OF KARNS MACHINE IN JOHNSTOWN, PENN., TUNNEL

of the head casting. The other half of the grooves or bearings is on the inside of the heavy steel nut encircling the hub. The back bearings are under the rear cap and are similar to the front, except there are but eight races of 3-in. balls, three in each row.

The middle cap covers the rotating device. It is the same as the front and back bearing except that the races for the 3-in. balls are spiral. There are four races with three balls in each race. On the outside of the steel nut there are ratchet teeth with dogs to drop into them on the back stroke and hold the nut from turning. This compels the shaft within to turn, as the ball races are spiral. On the forward stroke the motion is reversed and the nut turns, the dogs simply sliding over the ratchet teeth on the nut.

The engine driving this machine is a double, 9½-in., tandem cylinder, with an extreme stroke of 8¼ in. For operation, 2000 cu.ft. of air per min. are required. To operate this machine on each shift, one runner and helper, two muckers, one engineer and a fireman are necessary. A blacksmith and helper are required one shift in three. The cost per foot to drive a tunnel with this machine ranges, it is stated, from $1 to $5.

The machine was first tested by driving more than 100 ft. in solid granite, near Boulder, Colo. The most recent demonstration was a tunnel 6 ft. in diameter and 200 ft. long, driven for the Valley Coal & Stone Co., near Johnstown, Penn. To show the adaptability of the machine to requirements, a 10° curve was driven as shown in Fig. 2 of the illustrations. The machine is controlled by the J. P. Karns Tunneling Machine Co., Mercantile Bank Building, Boulder, Colorado.

Iron Silver Mining Company

In 1912 the Iron Silver Mining Co., Leadville, Colo., shipped 46,410 tons of ore having a gross value of $1,848,299, the net return to the company, after deducting freight and treatment charges, being $523,905. The lessees produced 16,294 tons yielding a net return of $112,705, from which the company received in royalties $15,107 and from other charges $2786. The total net income from all sources was $548,119, and the total expense $273,798, showing a net profit of $274,321 for the year.

Development work during the year totaled 8343 ft. distributed as follows: Drifts, 6543 ft.; raises, 1724 ft.; winzes, 76 ft. An oreshoot which was discovered in 1911 was proved for a length of 360 ft., showing an average width of 70 ft. and a thickness of 18 ft. Of this volume of ore practically one-half was mined yielding the bulk of the output produced from the Moyer mine during 1912. The remaining developed ore in this shoot ready for extraction is estimated by Manager George O. Argall to be 30,000 tons.

Another smaller and less important body of good-grade zinc sulphide ore was discovered between the second and third levels. A drift run north from the top of No. 53 raise recently cut a body of zinky iron ore. The greater part of this deposit so far opened is too low grade for shipping, and mining is being confined to those portions which carry a sufficient zinc content to be marketable. The deposit appears to be an extensive one and the indications are that a fair tonnage of profitable ore will be obtained.

In 1911 the company abandoned operations in the territory tributary to the North shaft. The territory has since been leased and the lessees have taken out a moderate tonnage. Owing to the high price of spelter prevailing during 1912 the lessees were able to mine some low-grade ore not marketable at the time the company was working this ground.

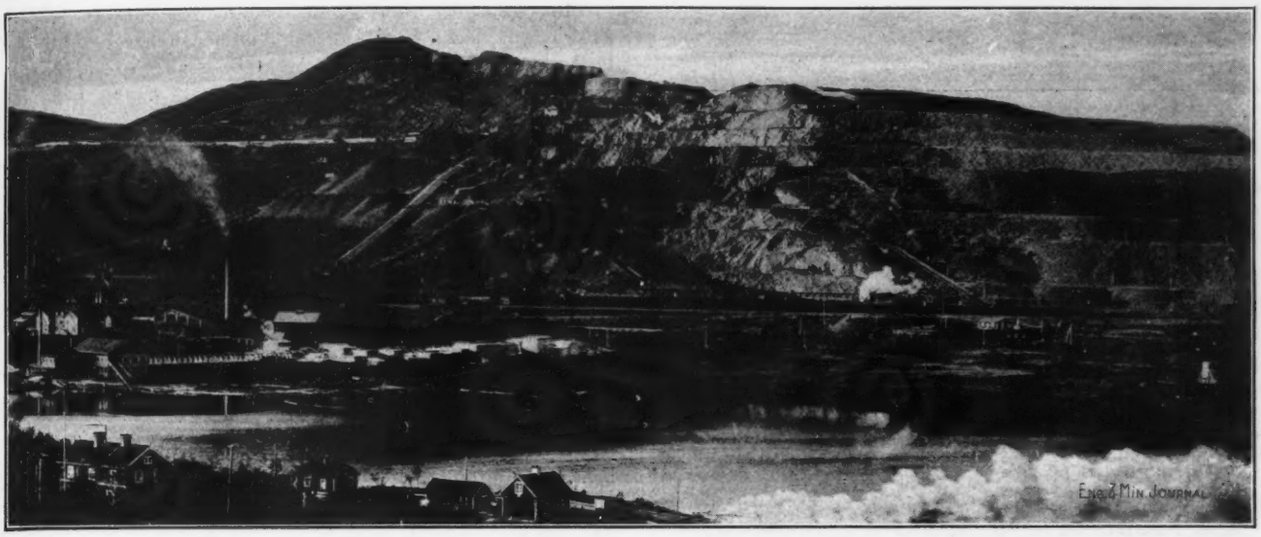
In the South Moyer mine, enough ore is actually blocked out to insure a maintenance of the present rate of production throughout 1913. Operations in the Tucson mine resulted in a production of almost 4000 tons in excess of the 1911 output, but the ore mined during the year was of lower grade, netting $3.84 per ton less than the shipments of the previous year. This decrease was due entirely to the exhaustion early in the year of the high-grade copper ore originally found along the Tucson fault. The development work in this mine was, on the whole, rather disappointing.

Stoping was resumed on the lower-grade zinc-carbonate ore formerly opened on the first level of the Tucson mine and a moderate tonnage shipped. The lead-carbonate ore deposit opened on the second level in 1911 contributed 8000 tons of a fair grade siliceous ore, and it continues to yield a steady production.

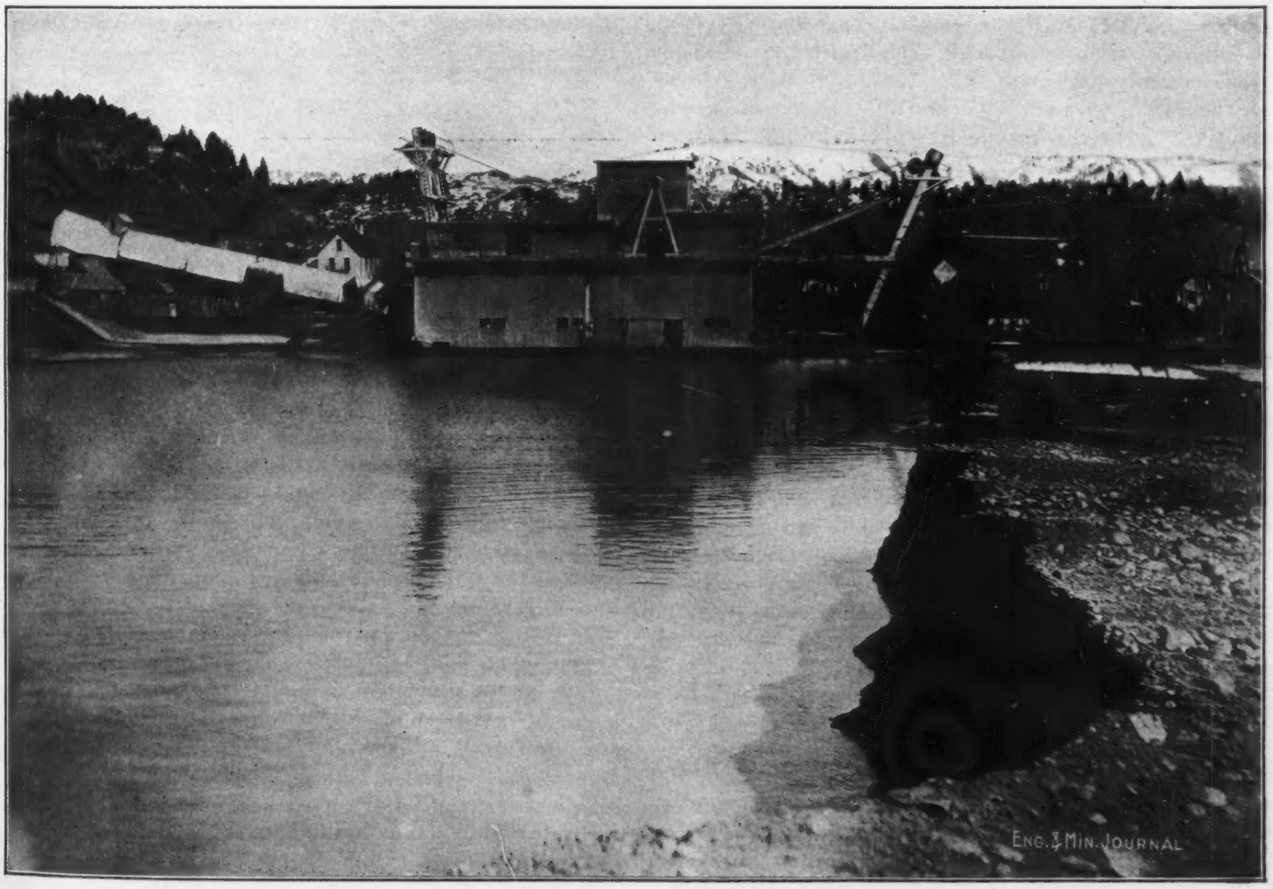
The metal content of the company ore produced in 1912 was as follows: Gold, 252.59 oz.; silver, 412,111 oz.; lead, 11,690,655 lb.; zinc, 15,659,255 lb.; iron, 1,767,992 lb.; copper, 56,410 pounds.

At the South Moyer shaft it was found necessary to install a new 10-in. water column as the old one had become so badly corroded by the action of acidic water as to render its continued use unsafe. A relief motor for the South Moyer pumps and an electric air drill for the Stevens mine were installed.

PHOTOGRAPHS FROM THE FIELD



KIRUNAVAARA MINE, ONE OF THE GREATEST KNOWN IRON DEPOSITS IN THE WORLD, SITUATED IN SWEDEN, 100 MILES NORTH OF THE ARCTIC CIRCLE



THE 14-FT. DREDGE OF THE BOSTON & IDAHO CO., OPERATING ON MOORES CREEK, NEAR IDAHO CITY

(Robert N. Bell, State Inspector of Mines, who supplied this photograph, calls attention to the clear figure of a man's face cast by the bank shadows of the pond.)

Dowsing in France and in Colorado

M. Viré, a professor at the Paris Museum of Natural History, is investigating, under the auspices of the Congress of Experimental Psychology, the subject of rhabdomancy or dowsing. He is assisted by M. Martel, president of the Committee of Scientific Studies at the Ministry of Agriculture, and other distinguished men of science. The *Evening Post* gives the following version of a recent experiment:

Twenty dowsers met at the Porte Daumesnil, near Vincennes, and were conducted by M. Viré to a part of the woods near the Saint Mandé Road, between Saint Mandé and Charenton. No one except M. Viré himself knew beforehand the exact place where the experiments were to be carried out, and he had borrowed unpublished plans showing the nature of the subsoil from the Préfecture of the Seine. The first experiment was an attempt to discover dry underground cavities by means of the divining rod. Four dowsers only, out of the 20 present, volunteered for this test. Each was armed with a wand of whalebone or metal, or simply with a twig. One dowser announced the presence of a dry cavity at a depth of 18 m., another that of a cavity of which he described the exact shape, and he also described four pillars near three old covered-up wells. The other two also divined dry wells, and the plans confirmed these discoveries. Later one of the dowsers stated that there was a quantity of coal at a depth of 140 m. It was, he said, one and a half meters thick. If this statement should prove correct the dowser has discovered something not to be found on the plans. Experiments in the discovery of hidden springs are being conducted at Argenteuil.

This reminds us of an experience in Leadville, Colo., 25 years ago, whereof we knew. Two ingenious persons arrived in camp one day with an "electrical mineral indicator" and, of course, had no trouble in interesting mining operators. Engaging exhibitions of how the well known oreshoots of Carbonate Hill could be traced on the surface by new comers to the district, presumably unacquainted with them, were given. Even the stopes of the Maid of Erin and Morning Star mines were mapped. Naturally the next step was for the manager of a prospecting enterprise to invite the e. m. i. men to examine his ground. This happened to a property overlooking Iowa gulch, where two fine shafts were being sunk, each down about 300 ft. Alas! the e. m. i. gave no readings worth mentioning anywhere in their vicinity. Intense gloom began to enshroud the party, when lo! just as the day's work was about to cease the e. m. i. began to give readings. Higher and higher they went at every 10 ft. At last it developed that nothing short of a bonanza had been indicated. The manager of the property was conservatively happy, his mouth saying little but his eyes expressing volumes. His foreman was exuberant. He said he always knew that the ore was in just that spot; that the two shafts were misplaced; and that he had intimated as much when they were started.

Well, the two shafts were promptly abandoned and a new one was begun. This was started as a very fine shaft, three compartments, stoutly timbered and lagged, and it went down straight as a plummet. At about 400 ft. it was expected that the ore would be found, but nary a bit was there. Nor at 500 ft.

In mining, especially in shaft sinking, hope springs eternal, so this shaft was continued to 600, then to 700 and 800 ft. Toward the last some nervousness was exhibited; not only was there no ore, but also there was no "contact." It was decided then to cease sinking and continue with a drill hole to find the contact. The latter was never found. At something like 1100 ft. the drill hole struck water, which came in with such pressure that the hole could not be plugged, the shaft was filled to within 300 or 400 ft. of the surface and the adventure in "dowsing" terminated. We were reminded of it by the "finding" of the unsuspected coal seam near Vincennes.

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Rio Tinto Company, Ltd.

The report of this company for the calendar year 1912, shows that there has been no change in the capital liabilities, which remain at £3,500,000, made up of 325,000 shares 5% preference stock, and 375,000 shares ordinary stock, both £5 par. There is no bonded debt. The general income account is as follows:

Profit on sale of produce	£2,274,869
Interest and miscellaneous	10,890
Total	£2,285,759
General expenses and taxes	£179,990
Directors' allowances	15,067
Depreciation	150,670
Staff provident fund	5,000
Total charges	£350,727
Net earnings for the year	£1,935,032
Balance from 1911	28,314
Total	£1,963,346

From this surplus the dividends paid and declared have been 5% on the preference shares, and 90% on ordinary shares; amounting in all to £1,768,750, and leaving a balance of £194,596 forward to current year.

The production statement is as follows in tons:

	1911	1912	
Pyrites for shipment	649,215	698,399	I 49,184
Ores for treatment	1,536,390	1,708,570	I 172,180
Total mined	2,185,605	2,406,969	I 221,364
Average copper content	2.144%	2.180%	I 0.036%
Copper produced at mines	21,880	25,623	I 3,743
Pyrites sold	662,259	688,861	I 26,602
Washed, and other sulphur ores	841,964	977,812	I 135,848
Total ores sold	1,504,223	1,666,673	I 162,450

The item of pyrites sold, includes material invoiced to customers for both copper and sulphur values. Other sulphur ores have no copper value.

The total quantity of copper sent to market in 1912, as refined and standard copper, or as copper in pyrites, was 39,925 tons. The market price of standard was much better than in the previous year, the average price being £73 1s. 3d. per ton, against £56 1s. 9d. in the previous year.

The report says: "The preparation of the lodes for the later removal of minerals has been continued. Machine drilling, both in opencasts and underground operations, continues to give satisfaction, and the steam shovels are working as usual. The company's railway and pier handled the shipments promptly, though they were larger than in previous years. . . . All the reservoirs, which were full in the early part of the year, have been heavily drawn upon, and will require careful nursing. . . . Affairs at the mines are in sound condition, and the demand for pyrites and sulphur ore continues to increase, and the future outlook in regard to the price of copper is not unsatisfactory. . . .

"The consumption of copper has increased, though not quite so rapidly as the production, which was engendered by the high price ruling during the last half of 1912. The world's stocks, however, are evidently reduced below the figures of 18 months ago, and today are low in comparison with the increased turnover."

CORRESPONDENCE AND DISCUSSION

The Shipment of Cyanide Precipitate

In the JOURNAL of Feb. 8, 1913, Mr. Megraw, in his excellent article upon "Cyanidation at Cripple Creek," refers to the practice pursued at the Independence mill of shipping the precipitate to smelters, saying: "The fact that precipitate of this class can be shipped at a cost less than that for treating it upon the ground is worthy of comment, for it is generally considered better practice to handle it at the plant where the chance of loss, due to differences in sampling, is less, to say nothing of transportation charges. This matter ought to be investigated, particularly by plants situated conveniently by smelting installations, as I believe that generally no investigations are seriously made, it being taken for granted that treatment on the ground is cheaper."

In commenting upon this feature of Mr. Megraw's article, Mr. Wheeler, in the JOURNAL of Feb. 15, 1913, doubts the wisdom of this course for various reasons, although he gives no definite figures to support his opinion. Surely so experienced an operator as Mr. Argall is not shipping his precipitate, in preference to local reduction, without good reason. The fact that this plant is situated convenient to smelteries and that gold precipitate is produced, may have its influence. In general, smelters do not buy this material upon the result of corrected assays, and, as it is a well known fact that the percentage of correction upon the assay of a product carrying largely gold is not so great as upon one in which silver predominates, it will be readily seen that the difference in favor of the smelter, arising from this cause, would not be so great as in the latter case.

The transportation problem is a serious one and, perhaps, is at its worst when long distances have to be covered by mule back or ox cart and steamer. I have seen various methods of packing tried, such as sacking in canvas and burlap, paper sacks inside of canvas protected by burlap, boxing, etc., but the only satisfactory method is to pack it in hermetically sealed tin cans protected by wooden cases. A satisfactory container for this purpose can be readily obtained at any cyanide plant by carefully opening and preserving the tin-lined wood cases in which the cyanide is received. These should be washed and dried. The precipitate is then placed in them, the tin cover soldered on, and the wood top securely fastened by nails or screws. A binding of light strap iron greatly strengthens the package and is desirable if it is to go any distance.

Cyanide operators would welcome comparative figures from Mr. Argall, showing the advantage of shipping precipitate instead of bullion. Various plants, with which I have been connected in the past, have shipped precipitate and then have later installed melting furnaces and shipped bullion. In every case it was felt that there was a distinct advantage, although no accurate comparisons were made, in favor of producing bullion, and in no case did any of these plants return to shipping precipitate after having once produced bullion.

A number of years ago I had an opportunity of making a thorough and fair comparison between the relative merits of shipping precipitate and the production and shipping of bullion, when Charles Butters requested me to go to Virginia City, Nev., and thoroughly investigate this feature of their practice. At this time the Virginia City plant was treating a considerable tonnage of Tonopah ore and old Comstock tailing. Both electrical and zinc precipitation were in use and the precipitate resulting from the two methods was quite different in character. The electrically precipitated material was high in lime and copper and also contained some lead. The zinc-box precipitate was similar to that produced in plants employing that method of precipitation when treating a silver-gold ore, except that it was not quite so high grade as that produced by present-day practice. The precipitate from the electric boxes formed the bulk of the product. Both classes of precipitate contained mercury and it was the practice to retort for its recovery until the Comstock tailing, which was its source, finally became exhausted, when retorting was discontinued.

From the beginning of operations at this plant it had been the practice to ship the precipitate, and this was continued long after the other Butters plants had found it to their advantage to ship bullion. It was generally supposed, owing to the refractory nature of the precipitate, and its low gold and silver content, that there was every advantage in favor of shipping precipitate rather than bullion.

I have no reason to doubt the accuracy of the sampling and assaying of the smelters to whom the precipitate was usually shipped, as their results generally agreed with the independent sampling and assaying at the mill; but, of course, it is to be understood that neither party made corrected assays. It will, therefore, be seen that the factor of dealing with an unscrupulous smelter does not necessarily enter into the case in hand.

For the purpose of experimentation there was erected, under my direction, a single stationary pot furnace and a small cupeling furnace. It was planned to carry on experiments to determine the relative advantages of fluxing and melting directly in graphite crucibles, producing a bullion containing most of the copper; and melting in the cupel furnace with litharge and other fluxes, running off the slag and cupeling the lead, thus producing a high-grade bullion. A number of experiments were carried out along both lines and it was finally decided that it would be more advantageous to adopt the method of melting in pots.

The results obtained with the cupel furnace all showed a substantial gain over shipping, but as the pot method was the one finally adopted it will suffice to give comparative figures for that method and shipping. For that purpose I will give the results of two experiments made upon two samples taken from the precipitate comprising two separate and distinct shipments to the smelter.

These large samples were taken at the time that the precipitate was being sampled for assay prior to shipment. Every precaution was taken to have them truly represen-

tative of the mass of the material shipped, and in my opinion they were even more representative of the whole mass than the small samples taken independently at the mill and smeltery for assay. Assays upon these independent samples generally checked closely.

In the first shipment the fine ounces of silver and gold realized by smelting 460 lb. of precipitate and marketing bullion were 2302.60 and 40.3595, respectively. The fine ounces in 460 lb. of precipitate, as shown by the assays at the smeltery and mill, and upon which basis the lot of precipitate was sold, were 2250.01 of silver and 39.857 of gold. The gain in favor of shipping bullion was, silver, 52.59 fine ounces; gold, 0.5025 fine ounce.

COMPARATIVE COST OF SHIPPING 460 LB. OF PRECIPITATE AND PRODUCING AND SHIPPING THE BULLION FROM 460 LB. OF PRECIPITATE

Sampling and preparing for shipment	$2.16
Drayage	0.55
Express	15.94
Sampling at smeltery	1.15
Treatment charges	22.55
Deductions, gold	16.64
Deductions, silver	25.86
Total cost of shipping 460 lb. precipitate	$84.85
Cost of melting at $0.01[1] per oz. dorè bullion	$32.55
Canvas on bars, etc	0.30
Drayage	0.48
Express	11.86
Refining charges	33.38
Total cost of mleitng 460 lb. precipitate and shipping as bullion	$78.57

[1] This figure includes the cost of treating the byproducts. It is unusually high on account of the nature of the precipitate.

Net amount realized shipping bullion was $2074.04, and that realized shipping precipitate was $2026.88. a difference in favor of shipping bullion of $47.16.

This would amount to a saving of $0.02079 per fine oz. of doré bullion (fine ounces gold plus fine ounces silver).

In the second shipment the fine ounces of silver and gold realized by melting 300 lb. of precipitate and marketing bullion were 1297.71 oz. silver, and 21.532 oz. gold respectively. The fine ounces in 300 lb. of precipitate, as shown by the assays at the smeltery and mill, and upon which basis the lot of precipitate was sold, were of silver, 1263.94 and of gold, 21.61. The gain in favor of shipping bullion was 33.77 oz. of silver and 0.078 oz. of gold.

COMPARATIVE COST OF SHIPPING 300 LB. OF PRECIPITATE AND PRODUCING AND SHIPPING THE BULLION FROM 300 LB. OF PRECIPITATE

Sampling and preparing for shipment	$1.41
Drayage	0.36
Express	11.14
Sampling at smeltery	0.80
Treatment charges	12.83
Deductions, gold	9.08
Deductions, silver	14.66
Total cost of shipping 300 lb. precipitate	$50.28
Cost of melting at $0.01 per oz. dorè bullion	$12.11
Canvas on bars, etc	0.10
Drayage	0.17
Express	5.19
Refining charges	12.51
Total cost of melting 300 lb. precipitate and shipping as bullion	$30.08

The net amount realized when shipping bullion was $1167.66, and the net amount realized when shipping precipitate was $1129.49, a difference in favor of shipping bullion of $38.17. This would amount to a saving of $0.02969 per fine oz. of doré bullion.

The saving for four consecutive months, when the shipments of doré bullion amounted to over 50,000 oz. per month, was in July, $1090.52; August, $1056.21; September, $1178.67; October, $1003.61; a total of $4329 saving for the four months.

Although the cost of melting (1c. per ounce) was unusually high at this plant, due to the refractory nature of the precipitate, the saving in favor of local melting and the shipping of bullion is apparent. I have obtained costs of melting as low as 0.1c. per ounce in Central America, and others have done much better than this where a large volume of high-grade silver precipitate was melted under the most favorable conditions.

Within certain limits the treatment charge upon bullion is usually based upon a flat rate per gross ounce, so that while apparently the rate is no higher upon bullion containing considerable base material, as a matter of fact as the amount of base material increases, the rate per fine ounce of doré also increases in direct proportion to the increase of base. To illustrate how this might affect the saving due to melting, I have calculated the saving which would have resulted if bullion 950 fine had been shipped instead of the base copper bullion from the plant in question. During the four months mentioned, the saving in July would have been $1557.36, that in August $1508.40, in September $1683.24, and in October $1433.25. It will, therefore, be seen that where a high-grade precipitate is produced which can be converted into comparatively high-grade bullion at a low cost, the saving by local melting in a large plant is greater than that indicated by the figures which I have given.

The saving indicated in this case is plainly due to two causes: First, that the ordinary cyanide plant can actually convert silver-gold precipitate into bullion cheaper than the charge made by the smelters for this service; second, that with local melting and the proper treatment of the byproducts, more bullion is realized than that indicated by the ordinary uncorrected assays.

It is only fair to say that these comparisons were made a number of years ago and that the rates of treatment for precipitate and bullion taken are those obtaining at that time.

G. H. CLEVENGER.

Palo Alto, Calif., Mar. 16, 1913.

Cooling Reverberatory Bottoms

Noting Mr. Cloud's letter in the JOURNAL of Apr. 19, 1913, on cooling reverberatory bottoms, I was reminded that in Peter's "Modern Copper Smelting," tenth edition, 1899, on pp. 451, *et seq.*, preheating the air for the firebox by leading it through brickwork passages in the furnace bottoms both at Argo and Anaconda is fully dealt with. It is interesting to note, however, that while Herreshoff and Cloud both use this to keep the furnace bottom cool, Peters says: ". . . . If this be the case, a very great advantage must be derived from preheating the air. How much greater results might be derived from preheating the air by means of extraneous fuel, rather than by abstracting caloric from the hearth, would be interesting to know."

A. A. NASON.

New York, Apr. 20, 1913.

High Railways

In regard to the statement in the JOURNAL of Apr. 19, 1913, that the world's highest railway line is between the Mulato River, Chile, and Potosí, Bolivia, 15,000-ft. elevation, I believe the Galera tunnel on the Central R.R. of Peru (the Oroya railroad), is 15,665 ft. above sea level.

C. C. SEMPLE.

Stamford, Conn., Apr. 14, 1913.

EDITORIALS

The Metal Markets

Copper had had a substantial rally and the market looks strong. There is no doubt of the soundness of its statistical position.

Lead is also stronger, and its price is now about at what may reasonably be assumed as an average. The statistical position of this metal is always a matter of mystery, but such stocks as may have accumulated are probably being reduced with the advent of spring.

Spelter is now the weak sister, the decline in its price having been catacylsmal, but it has not yet sunk to such depths as the past has recorded and scarcely ought to. Stocks are beginning to accumulate at the smelteries. The smelters are never willing to carry much of this metal, and lately they have been so accustomed to having none at all that the piling up of a few tons seems to make them tremble in their knees and run to sell at any price.

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Two Porphyry Reports

The porphyry copper mining companies are beginning to make their reports for 1912. We shall comment upon them more fully in a later article. In the present we shall confine our attention to two of the older and well seasoned companies, viz., the Nevada Consolidated and the Miami.

The Nevada Consolidated is evidently going just the way that we indicated in a review several years ago, i.e., it is experiencing a steadily increasing cost of production per pound of copper. In 1912 this was 8.86c.; after crediting miscellaneous earnings it was 8.33c. The reason for this was primarily the lower grade of the ore treated, but the strike, and the greater costs of mining the Veteran, Liberty and Hecla orebodies were also contributory. In 1912 the quantity of ore treated was 2,852,515 tons, averaging 1.69% Cu. The remaining reserves of the company are estimated as 38,853,551 tons, averaging 1.67% Cu. or about the same in grade as the ore mined in 1912. At the same rate of mining the company has about 14 years of production remaining. which is rather better than has been commonly thought, and while the orebodies have been about delimited in their lateral extents, there is still a chance for development of additional ore at greater depth in certain parts of the property.

The cost of production by the Miami company in 1912 was 9.59c. per lb., the increase being attributed to adverse changes in labor conditions and the necessity of continuing the extraction of the top of the orebody by square-setting and slicing. A very gratifying feature of the report of this company was its showing of ore reserves of 20,800,000 tons, running 2.48% Cu at the end of the year; so this company had then more ore than it began with and is likely to increase its reserves still further.

Examination of the Nevada and Miami reports convinces us that the managers of these companies are telling us the whole truth and that in their cases the future is unlikely to produce any disagreeable surprises. We fancy that the cost of producing copper out of 1⅔ to 2½% ore is inevitably going to be between 8½ and 11c. per lb., according to the grade of the ore, method of mining, etc., and when we find figures like 9 and 9½c., in the official reports we experience the feeling that we are not being fooled and we are consequently inclined to regard the reporting of a 9c. cost as a badge of respectability.

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Our Absurd Mining Law

The ocean of mining litigation still contains innumerable uncharted or but poorly lighted hazards. The metal-mining engineer requires the genius of a Philadelphia lawyer and more skill than that of the Ancient Mariner or the Argonauts to guide his argosy safely past many a statutory Scylla and Charybdis established by a sapient Olympian Congress apparently for his protection but frequently only to result in his destruction. In the valuation of metal mines in the mining states apex suits are a factor seldom taken into account, and yet the experienced mining engineer, familiar with the mines west of the Missouri River, knows full well that mining litigation has caused incalculable expense and loss in nearly every camp of importance. Indeed, those which have escaped have done so principally by agreements among the different owners of mining claims, setting aside absolutely and forever certain provisions of the federal statutes contained in their patents.

It might be supposed that when our national law makers discover that existing laws are not regarded with favor by those for whose express benefit they were created and are not calculated to promote the best interests of an industry of vital importance to the entire nation haste would be made to correct and improve such unsatisfactory and out-of-date statutes and by the aid of the best advice obtainable to adapt them to modern conditions and demands. Such a supposition would appear to be entirely unwarranted. It is perhaps because litigation troubles affect only part of the mines part of the time and not all of the mines all of the time that there is at no time a universal and irresistible demand for revision.

It is sometimes said that there is no longer any need for revision because all the moot points have been settled by judicial decisions and no one need be in any doubt as to his rights under any conceivable state of facts. It is true that certain principles have been established and that there is not such frequent uncertainty as formerly over possible interpretations of the apex law. But it is likewise incontrovertible that there are many questions yet to be determined by the highest courts, and upon which it is difficult to find two mining lawyers who will agree as to the probable ultimate decision.

Within the last two years there have been at least three cases where new questions have arisen in which the decisions of the lower courts have been greeted with much

shaking of heads and surprise on the part of the learned counsel for one side or the other. In the Lucky Corner case it was held that a junior claim, admittedly fraudulent and invalid by reason of no "discovery," but more than six years after patent, and hence invulnerable through the statute of limitations, possesses rights on a secondary vein apexing within its boundaries superior to the rights which the claim would have possessed had it been located honestly with the lines as they were actually laid on the ground and with a discovery upon the only vein of value apexing within them. The decision of the lower court was affirmed in the Court of Appeals, but there are still many excellent authorities who question its correctness and ultimate affirmation. Granting that the statute of limitations is a wise provision for protecting innocent purchasers and diminishing the number of lawsuits, yet it seems an undue extension of its benefits and effects to make it a weapon of offense against perfectly valid and unsuspecting claims located honestly and at an earlier date.

In the Golden Cycle case, now pending on a demurrer before the Circuit Court of Appeals, is raised the question of a junior's extra-lateral against the senior's intralimital rights, where the claims are so located that both have the apex. The questions as to what so constitutes possession as to give the courts equity jurisdiction and whether two parties can at one and the same time have such possession as to enable either to maintain a suit in equity are also here to be decided, and able counsel on each side are equally positive of a victory. In the Stewart case recently tried in Idaho the question as to what constitutes a side edge, and a top or bottom edge of a vein when cut off by a fault and under what conditions such an edge become a subfault or superfault apex was up for decision. It goes without saying that appeals would be taken in all such questions, for no one really knows what the ultimate authority will hold and the values involved run up into hundreds of thousands of dollars.

There are many such questions still to be determined. New ones can be found in every mining district of the West, and there is no telling when they will all be settled. But there are also many important points of mining law regarding the rights and methods of operating mines which are not understood by the average mining engineer and which frequently entail unforeseen expense and delay. The experience of the National Mines Co. is a good illustration. Mining operations on a rather flat vein brought them to their side line at the depth of perhaps 600 ft. There they were stopped by apex litigation. Having brought suit to quiet title and successfully established their right to the vein given to them in their patent from the government they wished to cut a station and sink an inclined shaft in the footwall of the vein for the sake of working it beneath the property of their neighbors. The vein is small and the ground bad and it would be impossible to keep strictly within the vein with their mining operations. But, while the law gives the miner the right to follow his vein, it fails to endow him (as did the old German law) with any ground on either side of the vein. It was, therefore, necessary for the National company to buy at a high price land for which it had no other use and which was not known to have any mineral value, just for the sake of mining the vein which it had already bought once and again won by expensive litigation. It is customary in many districts to run crosscuts *ad libitum* through neighboring territory to open up new levels on a vein; but it is a form of trespass which may prove expensive and for which there is no warrant in the provisions of the law. The law grants the right to the owner of a vein's apex to follow it wherever it leads, but in doing so he may not take a pound of another man's porphyry or granite, just as Portia ruled that Shylock might have his pound of flesh but nothing more. In mining this is commonly unobserved, common-sense and common consent both disregarding the letter of the law, but the law may be enforced literally and strictly as was done at National. This comes pretty near, we think, to the acme of absurdity in our antique and clumsy mining law.

The Mexican Situation

The Mexican situation seems to have gone from bad to worse since the murder of Madero. The reports that come to us from Mexico are about unanimous as to this. Under Huerta and Diaz we were to have restoration of order by the exercise of iron hands, but even the latter are not effective when the purse is empty, which manifestly is the trouble now. After an orgy of bloodshed, crime and riot, the fiddler has to be paid and under the circumstances, which have led to the withholding of the endorsement of the United States, the money lenders have not shown any eagerness to supply funds.

In the meanwhile, many parts of Mexico are relapsing into barbarism, and horrible things are being done. The killing of Boris Gorow, which a correspondent described in a recent issue of the JOURNAL, is an example of what is happening. Shocking as it is, that story is, after all, rather mild in comparison with others that are told. In the meanwhile, also, Sonora is in rebellion, and there is talk of a repetition of the history of Texas.

For the first time we are now hearing of interference with the big mining companies, Cananea being in grave trouble. Operations had to be suspended there because there was too much difficulty in keeping the railway open. This checked the influx of money necessary to keep a large population going and naturally something happened, in which, of course, there was no guidance of wisdom.

It is perfectly obvious that a Napoleon has not yet appeared in Mexico and that chaos now prevails. Such leaders as there are see probably that the country is doomed to destruction if the sources of money be dried up. Some of them are manifestly thinking that there is no use in sending a tithe of the revenues to the capital and are reckoning on local appropriations of the whole, as, for example, in Sonora. In the meanwhile the bandits and brigands are exercising their own wills and exhibiting a barbarity and cruelty that causes the civilized world to shudder.

Tin-dredging is experiencing a noteworthy development, both in Malaya and in Nigeria. This has the interest of a nearly new art, and is stimulated, moreover, by the high price for tin. The world has been so well searched for gold-dredging ground that it may be now that tin-dredging opportunities will be easier to find than gold. American dredge builders have not yet participated in the tin-dredging business, but it is interesting to note nevertheless that some of the European builders are making use of American designs and drawings.

BY THE WAY

The following advertisement appears in a New York paper: TO MINING MEN—Practical woman miner, assayer, highly educated, used to mining life, would go as private secretary and help to good company or mining man; handle correspondence, typewriter; draw plans; can cook, turn hand to any mining occupation; good salary for most exceptional qualifications; might introduce foreign capital later. MINER, Box 124.

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The following description of mine investigation in Michigan, as given by a local paper, contains some valuable hints: "By blasting the virgin ore 500 lb. of the sedimentary rock were taken back with them. In Montreal this ore tested from 45 to 70% pure iron of the hematite quality from which bessemer steel, the very best, is manufactured. Also there was some of the magnetic variety from which pig iron comes."

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The case of Minerals Separation vs. Hyde is on at Butte. The plaintiff claims that by virtue of Hyde's alleged infringements the Butte & Superior has made a profit in excess of $3,000,000. (Will B. & S. stockholders please take notice and tell the glad news to the managers of the company, who lately have been rather distressed?) The defendant says the process was used and known as far back as the time of Herodotus. Now that will be *some anticipation* if the assertion can be substantiated.

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A subscriber of the JOURNAL, residing in Peru, writes to us as follows: "There is not very much going on here at the present time. Mining enterprise, according to Peruvian ideas, consists of spending five *soles* in a denouncement and then waiting for a "gringo" to come along who will pay out a fortune for a show on which the owners will not even go to the expense of perfecting their titles. It does me good to get the JOURNAL and read about things being done in camps where a wheelbarrow is not considered a complicated machine, as it is to lots of the *'gente'* down here."

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A mining engineer in Chile is responsible for the following: In the erection of a plant I employed a cosmopolitan group of so called "artisans." One day a carpenter who evidently had some doubt as to the correctness of his spirit level, borrowed a heavy plumb bob from a mason, suspended the bob from a nail and proceeded to test the vertical of his level, the operation being watched by the mason with curiosity and gravity, until a gleam of something like intelligence came into his eyes, and he resumed his work. The next day the mason borrowed the carpenter's spirit level to prove his plumb bob by.

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Le Chatelier, in summing up the work of G. Urbain, of the University of Paris, who was recently awarded the la Caze prize of the Academy of Sciences, gave the following data: During his researches on the rare elements, Urbain made over 100,000 fractional crystallizations, says the *Scientific American*. He first isolated the metal europium in a pure state, and identified it with bodies described by Crookes and Lecoq de Boisbaudran, who had attributed to it somewhat different properties, due to impurities. He established that gadolinium, which Demarcay had obtained in a pure state, is the same as the Crookes' victorium, this latter having yttrium with it. He produced terbium in the pure state, and identified it with Crookes' ionium. He identified dysprosium with bodies mentioned by Demarcay, Crookes and others. The most brilliant piece of work done by Urbain was to show that what was called ytterbium is in reality made up of three bodies, neoytterbium, lutecium and celtium.

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The Boston *News Bureau* reports the following interesting account of the closing of the Consolidated Mercur mine: "The last skip of ore was hoisted at 8.40 a.m. Sunday, Mar. 30, 1913, and the Consolidated Mercur mine was at an end. An hour before one of the oldest miners loaded the last car at the Mercur station. The car was decorated with bunting and flags, attached to the last train, hauled out by the motor and dumped in the Mercur pockets. As the last skip was being hoisted the flag was raised on the mill, the whistles were blown for one hour, the fire-bell, school-bell and church-bell were rung, and the famous old producer passed into history with due ceremony. It was an impressive occasion to those who have made Mercur their home for many years, and to whom the rumble of the tramway and of the skips was a part of their daily existence." We may add that the Mercur mine possessed a good deal of metallurgical interest, it being the first place in the United States where the cyanide process was successfully introduced. The early promoters of that process in the United States bungled things badly and the process came to be regarded askance. This was early in the '90s. The Mercur ore was peculiarly docile and the process proved successful there, which led metallurgists to think there might be something in the process in spite of its promoters.

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William D. Haywood, who needs no introduction to the mining world, has lately been running a strike among the silk mills of Patterson, N. J., or creating some kind of a disturbance, this being his present avocation, in connection with which he has charged that silk dresses are often six parts tin and only one part silk, the vile manufacturers thus deceiving the gentle consumers. To make things worse the tin is often obtained from dump heaps. Many women who think they are wearing silk dresses are in reality wearing tin dresses. This led one of the New York dailies to interview a silk manufacturer, who said: "Of course, silks are adulterated, or 'weighted,' with tin. I am surprised to find that it isn't generally known, as there has been no attempt at secrecy. Tin obtained from dumps isn't used even in the cheapest silk; I don't think such a thing would be possible. Perhaps it does seem strange that silk dresses are sometimes from 40 to 60% tin. The percentage of tin is seldom more than 60%, and in the filmy silks of light weave which are required by the fashions of today, it is impossible to use 60% of tin." Out of all this, chemists will deduce some glimmers of ideas about the detinning of scrap and the treatment of silk fiber with tin chloride (known in the trade as tin crystals). So far as we are aware, the changes in feminine fashions do not have any noteworthy effect upon the tin market. With tin at its present price, no lady ought to be ashamed to wear a tin dress, Mr. Haywood to the contrary notwithstanding.

Mob Rule at Cananea

J. S. Douglas, president and general manager of the Cananea Consolidated Copper Co., was ordered by a mob, on Apr. 21, to leave Cananea. Upon his arrival at Douglas, Ariz., he gave the following account of the matter:

"Trouble had been brewing for a week because the company had to shut down more than half its works for lack of fuel. Many of the 2000 men thrown out of employment had been given odd jobs and supplies, but that did not appease the majority. Early on Apr. 21, a crowd of 2500 persons surrounded the office and sent in a delegation of four, accompanied by Colonel Alvarado, of the state troops, and Prefect Durazo, with four demands.

"They declared I must immediately appoint a successor as general manager of the company; that I must leave Cananea at once, as under Article 33 of the Mexican Constitution, I had been adjudged by the people a pernicious character; that Governor Pesquiera would arrive Tuesday with the demand that the mines be reopened and all idle men put to work; and that if the company did not immediately operate the mines they would see that another company did.

"Colonel Alvarado had only 200 soldiers and was unable to control the situation. He advised me to leave, as did officials of the company, so I closed up my business as well as I could and left a few hours later."

Tariff on Ferroalloys

Strong protest has been made against the section of the metal schedule in the tariff bill numbered 106 in the new law and reading as follows: Iron in pigs, iron kentledge, spiegeleisen, wrought and cast scrap iron and scrap steel, 8% *ad valorem;* but nothing shall be deemed scrap iron or scrap steel unless second-hand or waste or refuse iron or steel fit only to be remanufactured; ferromanganese, chrome or chromium metal, ferrochrome or ferrochromium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrotungsten, ferrovanadium, molybdenum, titanium, tantalum, tungsten or wolfram metal, and ferrosilicon, 15% *ad valorem*.

Complaint is being made on the ground that there are bunched together in this section products varying in price from $12 to $500 per ton. Ferromanganese, which was given $2.50 per ton under the present law, would probably be dutiable at the present English price at about $8.70@9 per ton, or between three and four times the old rate. The importations of ferromanganese last year were about 125,000 tons and during the year the article varied from $38 to $65 per ton. The variation is so great, that it is claimed the revenues will suffer seriously through lack of certainty on the part of the appraisers concerning the proper basis of duty.

Tamarack Mining Co.

The report of the directors of the Tamarack Mining Co., of Michigan, for the year ended Dec. 31, 1912, shows a total of 7,908,746 lb. of fine copper produced at an average sale price of 16.56 cents. Running expenses at the mine are placed at $940,903, with smelting, freights, commissions, Eastern office, etc., $87,709, or a total of $1,028,613, leaving a profit for operations for the year, $271,625. From this is to be deducted balance of interest paid, $11,580, making a net profit of $260,044.

The holdings of the company in the Hancock Chemical Co. and the Tamarack-Osceola Copper Manufacturing Co. were sold.

The total assets for the company are placed at $1,500,152 and total liabilities, $379,290; an excess of assets over liabilities of $1,120,861. Conditions are said to be satisfactory at the mines. In 1912, 428,568 tons of rock were hoisted and 7183 tons or 1.7% was discarded. The smaller percentage of discard in 1912 as compared with the previous year is largely accounted for by the fact that, in 1912, no large amount of opening work was done and a closer selection of rock was made in stoping.

Rhodesian Mining Notes

Heavy rains have now fallen all over the country and the mining industry has suffered and will suffer largely from the increased cost of provisions and produce.

The Giant mine has failed to discover any continuation of the large orebody in depth. The grade of ore milled has fallen off, owing to falls of country rock in the shrinkage stopes, and Rhodesia will shortly lose a large producer. At the Shamva mine, the ore has been penetrated for 30 ft. on the 4th level and averages 11 dwt. in value. At the 9th, or deepest level of the Lonely mine, 200 ft. driven assays 2 oz. 15 dwt. over 67 in. Apparently, however, this fine shoot of ore, nearly 1000 ft. long, is shortening in the lower levels.

The East Gwanda mines, comprising the Jessie and West Nicholson mines, some of the earliest producers, have gone into liquidation. The formerly rich Bucks Reef mine has shut down and the Jumbo mine is nearly worked out. A new large orebody, "a virgin reef," has been discovered near Concession Hill, Hartley. In Northern Rhodesia the Kafue mine has stopped smelting after producing matte worth £100,000, as with present rail freights it costs £60 per ton to produce copper.

George A. Denny and H. S. Denny have interested Dr. Hans Sauer, who was formerly connected with several Rhodesian companies, and have formed a company called the Selected Mines of Mexico, Ltd., with £100,000 capital.

The tin boom in Rhodesia has quite subsided, as apparently not one really payable orebody has been found in the pegmatite dikes in any district. The copper production is at present nil. Chrome-iron ores are shipped over 500 miles by rail from the Selukwe district to Beira and thence to Europe at a small profit.

Alunite as a Fertilizer

According to recent experiments by the Bureau of Soils (*Circ.* No. 76), tests on ignited alunite show it to be about as effective as pure potash salts, when equal weights of K_2O are furnished in the two forms. That is, apparently there is no reason for leaching the potash content of the ignited alunite, and then evaporating to recover the pure potassium sulphate, unless to save excessive freight and packing charges.

Reported in New York

The Miami cave is not thought to have done any serious damage to the mine.

Four men were killed and nine injured by an accident in the shaft of the Leonard mine at Butte, on Apr. 23.

PERSONALS

H. L. Venables is on his way from Bolivia to London, England.

Dr. H. S. Drinker, president of Lehigh University, is on a trip to Panama.

Wilbur Judson is in Ydalpom, Shasta County, Calif., and will return soon to Tucson, Arizona.

Dr. J. A. Holmes delivered the class-day address at the Michigan College of Mines on Apr. 24.

Jerry B. Sullivan, of Iowa, has been appointed a member of the Board of General Appraisers of Customs.

Thomas H. Leggett, chief consulting engineer for the American Smelting & Refining Co., is in the Southwest.

Bulkeley Wells, general manager of the Smuggler-Union Mining Co., Telluride, Colo., is visiting New York and Boston.

W. L. Saunders, president of the Ingersoll-Rand Co., New York, has been appointed a member of the New Jersey Harbor Commission.

Edwin J. Collins, who has been engaged in examination work in Arizona and New Mexico for the past month, has returned to Duluth.

John I. Kane has been temporarily transferred from the Charcas to the Angangueo (Michoacan) unit of the American Smelting & Refining Co. in Mexico.

George M. Ryall, vice-president of the Pacific Smelting & Mining Co., who was "marooned" at Guaymas, Sonora, by the new revolution has returned to New York.

Francisco Massillon, formerly at the Altos Hornos iron mine, La Vigas, Vera Cruz, Mexico, is now at Buenos Aires, engaged in the development of a solar engine.

E. M. Rabb, engineer for the Gold Road Mine Co., of Goldroad, Ariz., has been appointed mine superintendent for the company in place of S. A. Holman, resigned.

Thomas F. Dowling, Trussville, Ala., has been appointed superintendent of the blast furnace of the Standard Steel Co., Alabama City, Ala. He succeeds James T. Gibson, resigned.

Roscoe T. Allen, formerly employed by the Dolores Mines Co., Chihuahua, Mexico, has taken a position on the metallurgical staff of the New York & Honduras Rosario Mining Co., San Juancito, Honduras.

W. M. Brewer has returned to Victoria, B. C., after an absence of eight months, spent in Alaska, where, in the vicinity of Valdez, he has been prospecting a gold-mining property and installing a small stamp mill.

Robert E. Cranston, mining engineer, has severed all connection with the Brazil Co. and will resume the practice of his profession with headquarters in San Francisco. Mr. Cranston is now on the way home from Brazil.

William J. Dixon has been made superintendent of the labor and transportation departments at the Edgar Thomson steel works and blast furnaces of the Carnegie Steel Co., at Bessemer, Penn., succeeding Thomas Cosgrove, deceased.

H. Kenyon Burch, chief engineer for the Inspiration Consolidated Copper Co., is making a tour of various mining properties throughout the Southwest, and will spend a few days in Los Angeles before his return to Miami, Arizona.

R. F. Randolph has been promoted to the general superintendency of the Saucon plant of the Bethlehem Steel Co., South Bethlehem, Penn. W. Frank Roberts has been appointed general superintendent of the Lehigh plant of the company.

Mr. Kelsey has resigned as superintendent of the Hardenberg mine and is succeeded by Mr. Dulard of Sutter Creek, Calif. It is understood that Mr. Kelsey will continue in the employment of Henry Malloch, manager of this mine and the South Eureka.

W. C. McKee has been appointed superintendent of blast furnaces of the Inland Steel Co., Indiana Harbor, Ind., succeeding J. E. Thropp, Jr., resigned. W. J. Rossman has been appointed to take charge of the labor department, succeeding Fred H. Fish, resigned.

Otto Ellerman, of Sturgis, S. D., has been appointed to fill the office of state mine inspector of South Dakota for a term of two years, in place of R. L. Daugherty, whose term has expired. Mr. Ellerman is a graduate of the State School of Mines, and is considered a competent man for the position.

Dr. T. Poole Maynard, mining and consulting geologist of Chattanooga, Tenn., has just been appointed consulting geologist with the Central of Georgia Ry. The study of the mineral resources along the line of the Central Ry. should result in the rapid development of the materials contiguous to this line.

James Bowron, who has been trustee in bankruptcy of the Southern Iron & Steel Co., Birmingham, Ala., is president of the Standard Steel Co., which company took over the properties of the former concern. Other officers are as follows: H. Sanborn Smith, vice-president and general sales agent; A. R. Forsyth, secretary and treasurer.

Following the resignation of A. P. Turner, president of the Canadian Copper Co. several changes have been made in that organization. John Lawson, formerly vice-president, has been made president: J. Agnew, formerly smelter superintendent, has been made general superintendent and W. Kent, who had charge of the reverberatory furnaces, has been made smelter superintendent.

A dispatch from El Paso, Tex., on Apr. 17, reported that James S. Douglas and S. W. Applewhite, respectively, president and secretary of the Cananea Consolidated Copper Co. were held for ransom in Mexico by striking miners or insurgents. A later dispatch, Apr. 21, says that they were expelled from Cananea by strikers, and ordered to take the direct road to the American border.

OBITUARY

Lucius E. Cochran, of Youngstown, Ohio, died at Cairo, Egypt, Apr. 12, aged 71 years. He was on a tour with Mrs. Cochran and a party of friends. He was born in Delaware County, Ohio, and for 53 years had been engaged in the iron and steel business in the Mahoning Valley. He had been connected with several different companies and had been president of the Youngstown Iron & Steel Co. for 12 years past.

SOCIETIES

American Institute of Mining Engineers—The New York Section will hold its annual meeting for the election of officers at the Engineering Societies Building, on the evening of May 2. A paper will also be presented.

Society of Chemical Industry—The New York Section on Apr. 25 held a joint meeting with the New York Sections of the American Chemical Society and the American Electrochemical Society. The program for the evening included a lecture on "The Corrosion of Iron and Steel," by William H. Walker, illustrated with specimens and lantern slides. This paper presented important facts relative to the corrosion of iron and steel as determined by careful observers within the last five years. A second paper on "Concrete Construction, Old and New," by Maximilian Toch, was also illustrated with lantern slides and described modern methods of concrete construction as well as the older ones.

Montana Society of Engineers—This society held its 26th annual meeting at Butte, April 12. At the morning session officers were elected, and reports of committees received. In the afternoon, the retiring president, Robert McArthur, read his annual report of the progress of the state during 1912, in mining and other engineering development, and the meeting ended with a banquet in the evening. Officers for the ensuing year were elected as follows: President, J. H. Klepinger, Great Falls; Vice-president, Reno H. Sales, Butte; second vice-president, Martin H. Gerry jr., Helena; secretary, Clinton H. Moore, Butte; treasurer, Samuel Barker, Butte; trustees three years, Harry H. Cochrane, Butte; George A. Packard, Butte, and W. T. Burns, Great Falls. Seven new members wer admitted to the organization: Paul A. Gow, Christopher A. O'Brien, John J. Johns, A. F. Monroe and Hugh McLeod, of Butte; Roy B. Williams, who is in charge of the reclamation work at St. Ignatius Mission, Flathead County, and Fred E. Buck, of Stevensville. C. W. Goodale, and C. H. Moore made interesting addresses on the subject of good roads, stating that a member of the Good Roads Association of Montana, attended the Good Roads Congress at Logan, Utah, and succeeded in having Anaconda selected as the next meeting place of the congress, and for the Government exhibit of road models. The announcement was also made by C. W. Goodale that the next annual convention of the American Institute of Mining Engineers would be held in August.

Iron & Steel Institute—The annual meeting will be held in London, May 1 and 2. The annual dinner will be held May 1. The Bessemer gold medal will be presented to A. Greiner. The Andrew Carnegie gold medal for 1912 will be presented to J. Newton Friend, and the awards of research scholarships for the current year will be announced. The following is the list of papers that are expected to be submitted:

1. "Critical Ranges of Pure Iron, with Special Reference to the Point A_2," by Dr. H. C. H. Carpenter, Manchester.
2. "Influence of the Metalloids on the Properties of Cast Iron," by H. I. Coe, Birmingham.
3. "Economy of Dry Blast," by Professor J. von Ehrenwerth, Leoben.
4. "Corrodibility of Nickel, Chromium, and Nickel Chromium Steels," by Dr. J. Newton Friend, Worcester; J. Lloyd Bentley and W. West, Darlington.
5. "Influence of Silicon on the Corrosion of Cast Iron," by Dr. J. Newton Friend and C. W. Marshall, Worcester.
6. "Influence of the Presence of Sulphur upon the Stability of Iron Carbide in the Presence of Silicon," by W. H. Hatfield, Sheffield.
7. "A New Form of Electrically-Driven, Two-High, Continuous-Running, Reversing Mill," by Andrew Lamberton, Coatbridge, N. B.
8. "Studies in the Cold Flow of Steel," by Percy Longmuir, Sheffield.
9. "Rolling-Mill Practice in the United States, Part II," by Dr. J. Puppe, Breslau, Germany.
10. "Faults in Present-Day Furnaces and Their Remedies," by Alleyne Reynolds, Brighton.
11. "A New Method for Accurate Determination of Phosphorus," by C. H. Ridsdale and N. D. Ridsdale, Middlesbrough.
12. "Tenacity, Deformation and Fracture of Soft Steel at High Temperatures," by Dr. Walter Rosenhain, Teddington, and J. C. W. Humfrey, Sheffield.
13. "Chromiferous Iron Ores of Greece," by Herbert K. Scott, London.
14. "Production of Sound Steel by Lateral Compression of the Ingot whilst Its Centre Is Liquid," by B. Talbot, Middlesbrough.

INDUSTRIAL NEWS

Sterling Gauge Co., 132 Larned St. E., Detroit, Mich., is offering a new liquid gage called the "Hydrocator." It is used for indicating the depth of water and other liquids in tanks, reservoirs, sumps, etc., and will show the depth on a gage at any distance from the tank itself. About 50 of these gages are used by the United States Navy.

A. Leschen & Sons Rope Co., St. Louis Mo., in their April bulletin, describe various types of dredges in which "Hercules" wire rope is used. The strain on dredging cables is heavy and the bending stress is great. It is believed that Hercules rope is well adapted to dredging work, combining the essential qualities of strength, toughness and flexibility.

The Kennicott Company, Chicago Heights, Ill., was recently awarded the John Scott Legacy Medal on the Kennicott water weigher or measuring device. This medal is awarded by the city of Philadelphia upon recommendation of the Franklin Institute for the advancement of the mechanic art. The award was made in consideration of its novelty, its simplicity of design and its accuracy as a water-measuring device. The principle of the operation of the weigher is described in Bull. No. 38, of the Kennecott Co., while its purpose is set forth in a booklet entitled "The Value of the Kennicott Water Weigher in the Power Plant."

The Metaline Company, 46 West Ave., Long Island City, N. Y., in its new catalog, describes the manufacture, application and advantages of "Metaline," a typical solid lubricant. The substances of which Metaline is composed are reduced to impalpable powders and then solidified under great pressure into short cylindrical plugs. These plugs are inserted into flat-bottom holes drilled into the bearing surface of divided bushings in such a manner as to supply the required lubrication. It is claimed that "metalined' bushings require no oil, or other lubricants. If properly applied and not oiled, it is stated that the bushings will last for years before new plugs need to be inserted.

The February orders of Allis-Chalmers company include four Blake crushers, 16 sets of rolls, four Hancock jigs, and a double-drum electric hoist for the Britannia Mining & Smelting Co., Britannia Beach, B. C.; two double-drum steam hoisting engines, Isbell vanner, and miscellaneous parts for a 100-stamp battery for Henry Ainsworth, Johannesburg, South Africa; four converter stands with motors and five 12-ft. diameter converter shells for United Verde Copper Co., Jerome, Ariz.; four special Blake crushers for the Anaconda Copper Co.; seven sets of crushing rolls for Pickands, Mather & Co., Duluth, Minn.; four 8-ft. Hardinge mills for Old Dominion Copper Mining & Smelting Co., Globe, Ariz.; six 8-ft. Hardinge mills for the Arizona Copper Co., Ltd., Clifton, Ariz.

TRADE CATALOGS

Ross-Tacony Crucible Co., Tacony, Philadelphia, Penn. Catalog. Crucibles. Illustrated, 22 pages, 5½x8 in.

Sullivan Machinery Co., People's Gas Building, Chicago, Ill. Bulletin No. 66G. Hammer drills. Illustrated, 32 pages. 6x9 in.

Spray Engineering Co., 201 Devonshire St., Boston, Mass. Bulletin No. 21. Sprays for cooling condensing water. Illustrated, 16 pages, 6x9 in.

Independent Powder Co., Joplin, Mo. A 90-page booklet illustrating and describing the various fields of operations in which the company's explosives find use.

Heine Safety Boiler Co., St. Louis, Mo. A 16-page pamphlet on "Superheating," containing notes on its economy and the design of superheaters to secure adjustment and control of steam temperature.

The Goulds Manufacturing Co., Seneca Falls, N. Y. Bulletin No. 114. Vertical, single-stage centrifugal pumps. Illustrated, 8 pages, 8x10 in. Bulletin No. 113. Rotary pumps. Illustrated, 16 pages, 8x10 in.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

POTASH—Process of Producing Potash from Seaweed. William Hatch, Terminal Island, Calif., assignor to George Mason and Richard Mason, San Pedro, Calif. (U. S. No. 1,057,827; Apr. 1, 1913.)

BORING MACHINE. Bernhardt Henrikson, Chicago, Ill. (U. S. No. 1,057,424; Apr. 1, 1913.)

DRILL—Rock Drill. Charles C. Hansen, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,057,732 and 1,057,733; Apr. 1, 1913.)

DRILLING—Rock-Drilling Engine. John George Leyner, Denver, Colo., assignor to the J. Geo. Leyner Engineering Works Co., Littleton, Colo. (U. S. No. 1,058,072; Apr. 8, 1913.)

DRILLING—Water-Conveying Apparatus for Ejecting Rock Drillings for Rock-Drilling Engines. John George Leyner, Denver, Colo. (U. S No. 1,058,073; Apr. 8, 1913.)

DRILLS—Valve-Motion for Percussive Tools. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,057,700, and 1,057,701; Apr. 1, 1913.)

EXCAVATOR. Frank R. Knight, Cornwall, N. Y. (U. S. No. 1,058,066; Apr. 8, 1913.)

MINE-CAR WHEEL. John S. Skelly, Monongahela, Penn. (U. S. No. 1,058,110; Apr. 8, 1913.)

SAFETY LAMPS—Lighting or Igniting Device for Lamps. August Fillunger, Mährisch, Ostrau, Austria-Hungary. (U. S. No. 1,057,536; Apr. 1, 1913.)

CRUSHING—Discharge Screen for Centrifugal Grinding Mills. Joseph F. Dietrich, Gold Hill, Nev., assignor to Paul Hahnewald, Avon, Colo. (U. S. No. 1,058,416; Apr. 8, 1913.)

CRUSHING MACHINE. Josiah E. Symons, Chicago, Ill. (U. S. No. 1,058,114; Apr. 8, 1913.)

ORE-MIXING AND SEPARATING APPARATUS. Alexander H. Smith, Glasgow, Scotland. (U. S. No. 1,058,111; Apr. 8, 1913.)

PULP CLASSIFIER. Ira F. Monell, Boulder, Colo. (U. S. No. 1,058,252; Apr. 8, 1913.)

SEPARATION—Improvements in and Relating to Electrostatic Separating Devices for Sorting Heterogeneous Materials, more especially Minerals, Metallic and Others, Sulphur, Phosphates of Lime and Like Materials. A. M. F. Blanchard, Asnières, France. (Brit. No. 6772 of 1912.)

SEPARATOR—Ore Separator. Albert E. Bookwalter and Max A. Dorland, Cœur d'Alene, Idaho. (U. S. No. 1,058,349; Apr. 8, 1913.)

ALLOY of Cobalt and Chromium. Elwood Haynes, Kokomo, Ind. (U. S. No. 1,057,423; Apr. 1, 1913.)

ALLOY of Cobalt, Chromium and Other Metals. Elwood Haynes, Kokomo, Ind. (U. S. No. 1,057,828; Apr. 1, 1913.)

CHANNEL FURNACES—Method of Working Channel Furnaces for Burning Ore Bricks. Arthur Ramén, Helsingborg, Sweden. (U. S. No. 1,058,099; Apr. 8, 1913.)

ELECTRIC RETORT FURNACES, Improvements in. J. Bally, Grenoble, France. (Brit. No. 16,041 of 1912.)

FUSING—Furnace. Walter S. Rockey and Hilliary Eldridge, New York, N. Y., asssignor to Metallurgical Research Co. (U. S. No. 1,057,883; Apr. 1, 1913.)

REVERBERATORY FURNACE. Antoine Verzier, Grand-Croix, France, assignor to Société Francaise d'Exploitation de Fours spéciaux á haute Temperature, Paris, France. (U. S. No. 1,058,647; Apr. 8, 1913.)

ROASTING—Improvements in or Relating to Roasting Furnaces. M. van M. de Lummen, Cologne, Germany. (Brit. No. 13,549 of 1912.)

SLAG—Treatment of Slag. George L. Danforth, Jr., Chicago, Ill. (U. S. No. 1,058,158; Apr. 8, 1913.)

EDITORIAL CORRESPONDENCE

SAN FRANCISCO—Apr. 17

Calaveras Copper Co. Is Building a New Furnace—It was found to be more economical to tear down the old furnace and rebuild than to repair the leak that had caused a temporary closing down. The plant for neutralizing the smoke had been completed prior to closing down and was found to operate satisfactorily in the test run. The smoke plant and the new furnace were designed by E. H. Wedekind and the construction has been under his personal supervision. During the time necessary for the completion of these improvements the ore being mined is being hauled to Milton on the Southern Pacific R.R. and shipped to the Mammoth smeltery, wagons and auto trucks being used.

The Chief of the Mining Department of the Panama-Pacific Exposition is Prof. Charles E. Van Barneveld, recently appointed. Professor Van Barneveld is the dean of the school of mines of the University of Minnesota. He is preparing to take up the exposition work immediately. He is a graduate of the McGill University of Montreal, and held a position in the University of Minnesota for 14 years, and during that period traveled extensively in behalf of the university. For six years prior to that period he was engaged in practical mining, in the southwestern states and in Mexico. He is the author of "Iron Mining in Minnesota." He was formerly a resident of California and is a landowner in the Sacramento and San Joaquin valleys. The mining building to be erected at the exposition will occupy an area of 350,000 sq.ft. It is proposed to make the exhibit greater than that of any previous exposition.

The Emerson vs. Kennedy Mine Suit, involving the title of the Bellwether mine, situated on the Bright estate within the limits of the townsite of Jackson, Amador County, has been appealed to the supreme court. This property was owned by the estate of S. W. Bright under a deed resting on the townsite patent of Jackson. Mr. Bright for many years held possession and prospected or developed the mine and also granted to others the right of development under purchase options. The land, including the mining claim, was purchased by the Kennedy Mining & Milling Co., at public auction from the administrator of the estate. Prior to the sale, H. D. Emerson posted location notices on the Bellwether claim, upon the theory that the mineral rights were excepted from the townsite patent by the United States, and that the mine claim was still a part of the public domain. In spite of this the Kennedy company purchased the entire holding. Emerson brought suit against the company to determine the rights of the respective claimants. The defendant's demurrer was sustained on the ground that a United States patent could not be attacked collaterally in the manner contemplated by the suit; that whatever standing the plaintiff had was in the federal courts. Two amended complaints were filed, which were disposed of by demurrer and the last ruling was without permission to amend. From this ruling the plaintiff has appealed to the supreme court. It is claimed by the plaintiff that there is no precedent for the ruling of the superior court and that there is no parallel case in the decisions in townsite cases in California. Many cases have been found that are similar, but not exactly like the present one.

DENVER—Apr. 18

Petition for a New Trial by the Work Mining & Milling Co. in the case brought against it by the Doctor-Jack Pot Mining Co., in which the plaintiff was awarded judgment of $432,000 has been denied by Judge J. A. Reiner, of Wyoming, sitting in the Federal Court for Judge Robert E. Lewis.

Bills Affecting the Mining Industry, recently passed by the state legislature, include a mine taxation bill providing for the assessment for taxation of 50% of the gross output of mines together with all of the net output. The tax commission states this will increase the valuation for state taxation about $15,000,000, and for Teller County alone about $7,000,000. The bill carries an emergency clause and will become effective immediately upon being signed by the governor. A bill intended to annul the effect of a recent supreme court decision as to mining leases was passed and authorized the directors of a corporation to lease its property without the consent of stockholders. It also provides for the cumulative voting of stock. A bill offering to prospectors and miners free analyses and assays of ores by the students and faculty of the State School of Mines with a view to encouraging prospecting and furthering mining was passed. It originated with Representative John R. Old a graduate of the State School of Mines. Two memorials were addressed to Congress, one protesting against the Federal conservation policy and the other requesting the establishment of a Federal testing plant at Silverton.

BUTTE—Apr. 16

The Anaconda Company's Coal Mines at Belt, Have Been Closed—The mines have been operated about 19 years and during the height of activity about 1000 men were employed. The company has other mines in eastern Montana and Wyoming which produce better and cheaper coal than the Belt mines, and for this reason the mines were ordered closed.

Production of the Washoe Smeltery and Boston & Montana Smeltery at Great Falls, was 22,900,000 lb. of copper, in March. This includes the production of the Anaconda, North Butte, Elm Orlu, and other custom ore. The East Butte company produced 1,250,000 lb. of copper, and with other small productions the total output of copper for the Butte district amounted to approximately 25,000,000 pounds.

The Wage Question Has Been Settled, after suspension of operations for more than six months, by the electricians engaged in the work of electrifying the Butte, Anaconda & Pacific R.R. at the Silver Bow County end of the line; work has been resumed. The contracts agree to $5 per shift for electricians, and $3.50 for laborers, eight hours being designated as a work day, including the time consumed in going to and from the shop, and the place of work, and overtime to be paid at the rate of time and one-half. Ten electricians and 16 laborers are now at work on the Butte end of the line, and as soon as the work on the main line is completed the branch lines to the various mines will be electrified. It is thought that in eight months the work will be completed.

Corbin Copper Co. Is Encountering Opposition of Butte Residents to its petition for permission to sink a shaft on the Gambrinus claim. This and the Belcher lode claims were recently acquired and are in the western portion of the residential district of Butte. The residents of that district fear depreciation in the value of their property resulting from the proposed activity of the company. In its petition the Corbin Copper Co. requests the right to sink a shaft just east of Excelsior Ave. and south of Copper St., and to build an overhead trolley line north across Copper and Caledonia Streets to connect with the Butte, Anaconda & Pacific R.R. At a recent meeting of the city council, called to consider the matter, several property owners were present, represented by attorney E. B. Howell. Mr. Howell stated that the people in that district had bought their property and had improved it by building residences to the extent of $250,000, and that if the mining company were allowed to carry out its plans, it would mean a depreciation in the value of this property of at least $100,000, and he claimed that, being in the nature of a franchise, a vote of the people was required. Charles R. Leonard, attorney for the company, said that the company by investing money in the mining property, had the right to sink a shaft where it wished; and with regard to the overhead trolley, he quoted a decision by the supreme court of the state with regard to a similar case, when a grant of street privilege was given to the Davis-Daly Mining Co. from the Colorado mine shaft to its dump. In that decision no distinction was made between a mining industry and a public utility like a street-car line. It was decided by the members of the committee before coming to any decision to take a trip to the locality and look into the matter personally.

SALT LAKE CITY—Apr. 17

An Endeavor to Obtain Metal Tariff Revision at Washington, more favorable than that indicated in the published program of the Ways and Means Committee was considered at a meeting of the Utah chapter of the American Mining Congress Apr. 12. A memorial was submitted by the Rocky Mountain lead and zinc ore producers, calling attention to conditions surrounding the production of these metals, and

especially touching upon the allied output of gold and silver. This will be forwarded to Congress. The memorial gives details of gold and silver production for several years with tables showing the importance of lead production as an avenue through which much of the gold and silver output of the country is produced. The special census of smelting for 1905 showed that much larger amounts of gold and silver come from argentiferous lead smelting than from copper smelting. In the mining industry of the Western States there is nothing akin to monopoly. Figures were given showing that the cost of developing gold, silver and silver-lead mines in the United States exceeds the surplus income of producing mines. Of 2845 producing precious metal mines employing 37,755 men, as listed by the census of 1910, more than 600 were producers of lead, as well as of silver and gold. If the gold and silver produced by these mines is figured as applied toward the cost of mining, leaving the surplus to the credit of the lead, the average surplus is less than ¾c. per lb. of lead produced. These data will be verified by tables now in preparation. If in addition to mining costs a sufficient amount is allowed for money spent in earlier years in developing the properties, then the average profit is less than ¼c. per lb. of lead produced. This is when New York prices are 1½c. per lb. higher than in London. If foreign lead is allowed to undersell the domestic market, through coming in at a low duty, many western mines must necessarily suspend operations. Restriction of the output of western lead ores would restrict the production of silver and gold. Replies have been received to previous messages sent by the Rocky Mountain lead and zinc ore producers to Washington voicing the sentiments of western producers on the metal tariff. Secretary Tumulty wired that the message to President Wilson will be submitted, and Chairman Underwood, of the Ways and Means Committee, replied that the committee will have the statements of the conference submitted to it, and that they will be given careful consideration.

NEGAUNEE—Apr. 14

Iron Ore Shipments for 1913 will probably be the largest on record, and mining men are predicting a total of 50,000,000 tons from the Lake Superior region. Prices are considerably higher than last year when the record shipment of 48,000,000 tons was moved. Navigation will open shortly, and it is announced that never before has the demand for boats been so strong. Preparations are being made for shipping a large tonnage of low-grade and siliceous ores in contrast to last season when only the Richmond mine in the Cascade district was very active in that class. Such low-grade mines as the Portland at Michigamme and the Traders at Iron Mountain, idle last season, are being reopened. Few of the mines have such large stockpiles as were on hand prior to navigation a year ago. As usual the port of Escanaba on Lake Michigan will commence shipping several weeks prior to the Lake Superior ports.

MIAMI, ARIZ.—Apr. 19

A Large Cave-In Occurred at the Miami Copper Mine early in the morning of Apr. 17. Three men were killed, two were fatally and eight seriously injured. The 300 ft. of capping caved and broke through from the 245 level to the surface over an area of about 450x500 ft. Shrinkage stopes north 500, 600 and 700 were filled. The men were not caught in the cave, but were killed or injured by the resultant terrific blast of air on the lower levels. While mining in the unaffected region will not be delayed, two units of the mill will not be operated for about one week. Concentrates will hereafter be shipped to the International smeltery at Tooele, Utah. Supt. N. O. Lawton made the following statement to the "Arizona Record": "We had been cutting out the irregularities and projections of ore under the capping on the 245-ft. level above the territory laid out for shrinkage stopes. The idea was to take out the uneven projections of ore under the capping and bring it down to a level floor, and eventually get the capping broken and let it down gradually so as to avoid a sudden fall. We had the level pretty well cut off on each side of a double row of pillars. There were five main openings or stopes on this level which were partially filled with the broken capping to 25 ft. in thickness on top of the timbered floor. These stopes were separated by pillars of rock and ore. The level covered an irregular area of from 50 to 150 ft. wide by 700 ft. long. The height of the ore above this level varied from 10 to 25 ft. The rock and ore was of exceptionally strong character, and there was no indication of weight or crushing. It was expected that should the capping start it would show weight at the 245 level. It was being watched carefully and there was no apparent movement of the ground on this level, but there was a little working in the shrinkage stopes Nos. 500, 600 and 700, which had been cut out 125 ft. below. It was not thought that the capping would come with any sudden slipping. When the stopes had been finished to the capping and the tops of the pillars blasted it was expected that there would be a gradual settling of the capping. The completion of this work was still about two months ahead. The ore in the back of the shrinkage stopes was noticed to be dropping some Wednesday, and the night shift reported that the ore in the shrinkage stope rooms was still dropping during the night. But as the 245 level had not shown any weight to indicate that the surface was moving, it was not thought that there could be any possible danger of a sudden dropping of the overburden. It appeared to be simply falling in the back of the stopes, gradually filling them. Mine Captain Wakefield and I were just preparing to go down at 7:30 o'clock this morning to make a complete inspection of the mine. At 7:45 a.m., while waiting for the cage, we noticed dust blowing up the shaft and immediately got into the cage and went down into the mine.

"We found the capping above the 245 level had broken off through to the surface, filling four of the stopes on the level, one stope still remaining open. It also filled the unfilled portion of the shrinkage stopes. Most of the men in that portion of the mine above the 370 level, where the cave occurred, had noticed the movement of the ground in the places where they were to go to work and came out into the drifts into solid ground. There were no men caught or injured by falling ground, the injuries being caused by the rush of air knocking them down and throwing them against the walls and timbers in the drifts. All the injuries occured to men on the 370, 395 and 420 levels where no ground fell. Men in the levels above were not hurt at all. The force of the air in the lower levels was severe, as is shown by the fact that one man who was sawing timber on the 395 level was thrown 75 ft. Damage to the mine was slight, if there was any. In fact the overburden had to be started but the intention was to have it settle gradually. There is no further danger to be apprehended from this source as all of the overburden is now broken to the surface over all the territory to be mined and the surface that has been broken will gradually settle as the ore is taken out."

DEADWOOD—Apr. 17

Leasing Is Producing Good Results at several places in the Black Hills, and there are indications that during the coming summer lessees will be important producers. The latest property to give good results at the hands of lessees is the Ironsides, on Squaw Creek, which is being developed by Phillips & Caretti, who have uncovered a body of sylvanite ore. The ore was known to exist, and had been sought by previous operators, who had passed close to it, in fact the present lessees drove about 15 ft. to cut the ore. The lessees are endeavoring to persuade the county commissioners to repair the wagon road down Squaw Creek to Maurice, on the Chicago, Burlington & Quincy R.R., a distance of about three miles, so that they can get an outlet for their ore. In the Bald Mountain district several properties operated by lessees are steady producers. The Golden Reward is leasing some of its properties which are at a distance from the main workings. The Imperial and Mogul companies are both leasing ground. In the Two Bits district the Monarch is a steady producer and on two adjoining properties lessees are endeavoring to find the continuation of the shoot.

COBALT—Apr. 19

Plans for Draining Cobalt Lake Have Been Completed, by the Cobalt Lake Mining Co. To carry on the work, two large turbine pumps, each having a capacity of 4000 gal. per min., will be set on scows in the lake near the Right-of-Way mine, and the water will be pumped into Farr Creek. It is estimated that from the time the pumps are placed in position until the lake is dry, will be from four to five months. The average depth of water is less than 50 ft., but there are some places where it is at least 100 ft. deep. The lake is 1¾ miles long and 800 ft. wide, and with the exception of 4½ acres at the south end of the lake, belongs to the Cobalt Lake Mining Co. The McKinley-Darragh-Savage company owns 4½ acres of the land under the lake. A concrete dam will be built at the south end of the lake to hold back the water from flowing in from Little Lake. From this dam, a flume will carry all the water that is needed for the steam plants and pumps around the lake.

SUDBURY—Apr. 19

Laying Out the Ground for the New Works of the Dominion Nickel Co., is being done by a large force of engineers. A large portion of the grading for the new smeltery has been completed, and while contracts for the machinery have not as yet been let, it is expected that they will be given out shortly. The company proposes to erect two large reverberatory furnaces, four blast furnaces, and basic converters. It is also stated that the company will refine nickel in Canada. There appears to be a possibility that this idea will be abandoned.

THE MINING NEWS

ALASKA

Seward Peninsula

KOTZEBUE MINING CO.—This company has purchased a large tract of land on the Inmachuck River, and has commenced the construction of a dredge capable of excavating 2000 yd. of gravel daily. Jafet Lindeberg, of Nome, and H. J. Pritchard are interested.

Skagway District

PLANS FOR A NEW STEAMSHIP LINE BETWEEN SKAGWAY AND SEATTLE calling at northern British Columbia ports have been consummated and the charter for the S.S. "Leelanaw" as the nucleus of the fleet will be closed soon. The company is to operate in connection with the White Pass & Yukon Route, by which it will be controlled. The line will at first handle principally copper ore from the Atlas mine near White Horse. The White Pass route has experienced difficulty in handling ore from this mine on account of the heavy shipments of canned salmon Now that the river vessels from the upper Yukon can enter Fairbanks the freight rate has been cut from $60 to $40 a ton.

Susitna River District

GOLD BULLION MINING CO.—This company has sold to L. C. Thompson and associates of Toronto five claims and two fractions on Willow Creek near the Little Susitna River at the head of Cook Inlet for about $450,000. The mine ha sproduced more than $170,000 since 1907. The property has only been worked about five months altogether.

ARIZONA

Cochise County

COPPER QUEEN—There is a good showing of ore in the upper tunnel 175 ft. from the portal.

SOCORRO—A quantity of $300 ore has been sacked for shipment; this comes from the top of a large shoot recently uncovered.

MASSOLETTI—A 5-ft. shoot of gold ore has been encountered at a depth of 120 ft.; 2 ft. of this assays $60 and is free-milling.

Mohave County

DIXIE QUEEN—The Pacific Investment Co., controlling this property, is planning to equip it with a small cyanide

GRAND CANYON GOLD DREDGING CO.—This company has been organized to dredge the gravel deposits along the Colorado River below the mouth of the Grand Cañon.

DOYLE—C. L. Davidson, of Kansas, has taken an option on this property in the Aubrey district. A gasoline hoist will be installed and the shaft will be sunk 50 ft. deeper.

SONOMA—The shaft on this property at Silver Hill, near Chloride, has been sunk to a depth of 100 ft. and the drifts are in ore. As soon as the stopes can be properly opened up, this mine will probably become a regular shipper.

DE LA FONTAINE—This and the Cupel properties, upon which the Swansea Consolidated Smelting Co. has an option, were recently examined. As soon as some necessary repairs and improvements can be made, shipments of ore to the smeltery will be made.

GOLD ROAD—The two bars of bullion recently shipped from this property were valued at $50,000. A rich strike has been made on the 500-ft. level on the Billy Bryan claim. A drift has been driven about 100 ft. into the rich vein, but no stoping has been done.

BOUNDARY CONE—The shaft is 550 ft. deep and a drift is being driven east to the oreshoot cut by a winze on the 450-ft. level; very rich ore was found in the winze. This drift is already in good ore, but has not yet reached the high-grade ore.

Pima County

THE TUNGSTEN PROPERTY IN THE GUIJA MOUNTAINS, formerly owned by Bent & Sampson, of Tucson, is being operated by Max Junghandle.

MONTANA—This property has been purchased by Captain McDermott, of Tucson, with whom is associated Col. W. L. Powell and James Hoatson, president of the Calumet & Arizona. The first payments have been made and work is to be commenced at once. The property was formerly owned by L. Zerkendorf, of New York.

Santa Cruz County

AUGUSTA—This mine, which has a record of extensive shipments, is now under option to Calumet, Mich., men.

DUQUESNE—Preparations are being made to increase shipments to the Douglas smeltery. The ore is hauled by wagon to Patagonia 23 miles. The latest shipments returned at the rate of 16% copper and 5 oz. silver.

Yavapai County

DRILLING IN THE VERDE OIL FIELD HAS BEEN SUSPENDED for a few days while extensive repairs are being made to the equipment.

UNITED VERDE EXTENSION—Development is delayed pending the arrival of a compressor.

SWASTIKA—High-grade silver-lead ore has been encountered on the 300-ft. level; shipments will soon be made.

CLIMAX—The 10-stamp mill is running steadily. The Hidden Treasure mill is to be dismantled and the equipment added to that of the Climax.

COPPER BELT—Sinking has been begun on the No. 2 shaft and has reached a depth of 76 ft. Drifting will be started at the 100-ft. level.

COPPER CHIEF—Preparations are being made to ship ore at an early date to the new smeltery at Clarkedale. Several hundred thousand tons of ore are already blocked out.

ARKANSAS

Boone County

NEW YORK MEN ARE INVESTIGATING ZINC PROPERTIES in Arkansas, and it is reported that large holdings have already been secured. Henry F. Torrey is the engineer representing the purchasers.

TARKILN—This zinc property near Zinc is now controlled by a reorganization of the original company of Paterson, N. J., which has operated for some time and which built the mill.

CALIFORNIA

Amador County

KEYSTONE—The inclined shaft has reached a depth of 2680-ft. A station will be cut at the 2600-ft. level, and a west crosscut will be driven to the large oreshoot that was mined at the upper levels in former operations.

SOUTH JACKSON—After reaching the oreshoot in the drift at the 300-ft. level of this mine south of Jackson, development has been started on the 500-ft. level by a drift to determine if the ore goes down.

BUNKER HILL—A dividend of 2½c. per share was declared Mar. 15. The reduction in the dividend is caused by the large expense incurred in building the new steel headframe, the opening of the old outlet tunnel, connections with lower workings, the costs of the state liability law, the preparation for impounding tailing, and the further fact that the grade of ore is somewhat reduced in the month. E. Hampton is superintendent.

Butte County

MAMMOTH CHANNEL—It is reported that a drain tunnel will be driven to tap the channel at this Magalia property.

CRYSTAL HILL—The steam hoist at this mine at Magalia, which was recently destroyed by fire, will be replaced by an electric hoist.

Eldorado County

ORO FINO—This mine, formerly known as Big Cañon, three miles south of Shingle Springs, is reported to have been taken over by Englishmen. There is an inclined shaft about 600 ft. deep which is being unwatered. It is said that modern machinery will be installed. The ore is low grade and will probably be crushed and cyanided. The property was once operated by Hayward & Lane, but has been idle 12 years.

Kern County

HOOSIER—A 2-stamp mill, to be driven by steam, is being installed at this mine on the Bakersfield-Breckenridge road.

KEYES—Active development is in progress at this mine near Isabella. A 5-stamp mill is being built, which will be electrically driven.

NUGGET MOUNTAIN—This property, consisting of 16 claims, 14 miles northwest of Randsburg, has been taken over by Eastern men. A gasoline hoist will be installed and a new shaft sunk 200 ft. At that point the vein will be explored by drifting.

Nevada County

A DRY LAND DREDGE IS BEING INSTALLED ON DEER CREEK near the Herbert Kitts property. The dredge is to be 60 ft. long and 40 ft. wide. It will be electrically driven. Frann Porter of Grass Valley is superintendent.

BRUNSWICK—A new Dow electric pump, lifting 1200 gal. of water per min., has been installed.

GRIZZLY RIDGE—This mining company has taken over the Oak Flat, the Eddy and the Oustomah mines. The property is equipped with electric power for the mill, hoist and pump.

PENNSYLVANIA—Arrangements are said to have been completed for cyaniding the old tailing dump on a royalty basis by Homer Rhyne and Peter Eastman. It is estimated that the dump contains 30,000 tons

Placer County

HIDDEN TREASURE—This mine will be reopened. It has been idle for several years, and two years ago several of the buildings were destroyed by fire. The mine is situated four miles north of Michigan Bluff on the Forest Hill divide. It was a large producer and was worked through several thousand feet of tunnels and drifts. There are five claims located on two channels. Harold T. Power, of Oakland, is manager.

Plumas County

FIVE BEARS—It is reported that work will be resumed at this copper mine in the Genesee district.

LIETRUM—Development of this old property, which was reopened about a year ago, has disclosed a shoot of milling ore. The property is in Bullfrog district.

ALTONA—Work is to be resumed as soon as the snow melts. The reopening of the property was begun about a year ago by Seattle and Alaska men. The old tunnel has been retimbered and 700 ft. of track laid, and a shaft sunk 230 ft. below the tunnel level, from which point a drift was driven 150 ft. A stamp mill and steam hoist were installed. The property is in the Greenville district.

Tuolumne County

SPRINGFIELD—A record was made in shaft sinking at this mine west of Columbia in March. The shaft was sunk 195 ft. in 30 days. Machine drills were used. Three shifts of four men each did the sinking, timbering and mucking. Two men framed the timbers. The property is owned by the Springfield Tunnel & Development Co. A. L. Horner is manager; Joseph S. Cademartori is superintendent.

COLORADO

Gunnison County

TIN CUP GOLD DREDGING CO.—This company, owning 1900 acres of ground in the Tin Cup district, is hauling dredge machinery, including a Marion dredge of the elevator type, from St. Elmo, on the railroad. The company will build its own power plant and expects to be ready to begin operations July 1.

Lake County—Leadville

ALARMER—Work will be resumed about May 1 at this placer at Everett, a few miles above upper Twin Lakes.

MOUNT CHAMPION—A 100-ton concentrating plant has been completed; 30,000 tons of gold ore is broken in the levels ready for the mill. In the recently made gold strike the vein is 6 to 15 ft. wide, and the smelting ore assays from 1 to 19 oz. gold per ton.

San Juan Region

THE BUILDING OF A SIX-MILE CUSTOM TRAMWAY from the Atlas mill via the Camp Bird to Ouray is being talked about. This tramway would also serve the Humboldt and Mountain Top mines.

HUMBOLDT—This mine has been developing ore of very satisfactory grade on the third level, and the company proposes to do extensive development and build a mill this year.

WANAKAH—It is stated that this company will not cooperate with the Brown Mountain smelter, but plans are being made for the erection of a 100-ton pyritic smeltery as the company's supply of ore is sufficient to operate the furnace for three years at full capacity.

MOUNTAIN TOP—This company which owns the northerly end of the vein covered by the Smuggler-Union and Humboldt is advancing the crosscut to the vein, at a satisfactory rate. It is estimated that the vein should be reached early in June. The small feeders which have been cut are heavily mineralized.

CAMP BIRD—It is rumored that 9 to 12 ft. of very high-grade ore has been encountered on the No. 5 level going east from the No. 3 shaft. At the same time it has been said that more satisfactory ore was found on the No. 6 or deepest level in this shaft. Preparations to sink 200 ft. deeper are being made.

ATLAS MINING & MILLING CO.—During the latter part of 1912 the tramway was changed from "jig back" to continuous, and a sorting plant was installed in the mill; three Deister tables have been added and it is contemplated to make some additions this year. The ores are complex and difficult to treat. Recent cyanide tests made by Charles A. Chase indicate a fair extraction on the mill tailings, which should bring the combined recovery by concentration and cyanidation up to 90%. Other methods are, however, under consideration and it will soon be determined of what character the contemplated improvements are to be.

Summit County

PRODUCERS OF LOW-GRADE ORE IN THE BRECKENRIDGE DISTRICT will be forced to close down, because of the doubling of the freight rates on zinc ores by the Colorado & Southern Ry.

WELLINGTON MINES CO.—An electric pump is being installed which will permit draining the Oro shaft and developing the lower levels.

FRENCH GRAVEL DREDGING CO.—After running about one week, an accident occurred to this company's boat, which will delay operations about 30 days. The bank caved.

DUNKIN—An option on this mine in the Illinois Gulch part of the Breckenridge district has been given to Eastern men and an investigation of the property will be made.

SIMCOE MINING & MILLING Co.—This company is operating the Country Boy mine, which is being developed in the lower tunnel 1150 ft. long. A station has been cut 1050 ft. from the portal, and an electric hoist and electrically driven compressor have been installed. A winze 4½x9 ft. in the clear has been sunk 100 ft.; 6x8-in. cribbing is being used. A pump station is also being cut. A cross-cut is to be driven about 70 ft. to reach the vein which is a fissure vein producing high-grade ore; previous shipments having averaged more than 50% zinc. Development is being done on the tunnel level.

Teller County—Cripple Creek District

GAYLORD—The Gaylord mill is now treating about 1800 tons of ore per month.

GOLDEN CYCLE—The ore house is being enlarged so that the output of the mine may be increased from 6000 to 9000 tons per month.

PORTLAND—A 10-ton gasoline locomotive is now used for removing tailings, from the Victor plant to the dump ground at the top of Battle Mountain. It can haul 90 tons on the level. All tailings are dewatered and stacked in order to keep fine sand and slime out of irrigating ditches. Enough dump room has been acquired to last 22 years at the present mill capacity of 500 tons per day.

MICHIGAN

Iron

VIVIAN—This low-grade mine of Pickands, Mather & Co., at Quinnesec, on the eastern Menominee range, is to be reopened. The ore contains 38% iron and 41% silica.

SWALLOW & HOPKINS—An option has been taken on a 40-acre tract in the Crystal Falls district; the land lies southwest of the Carpenter-Monongahela properties of M. A. Hanna & Co. and is well situated.

MANSFIELD—At this mine in the Crystal Falls district, leased by the Oliver Iron Mining Co, operations are practically at a standstill, although the pumps are being kept at work. It is not known whether or not the lease, which has expired, will be renewed.

JONES & LAUGHLIN—This company has recently placed a diamond drill at work near Greenwood west of Ishpeming. Exploration has been carried on intermittently in this vicinity for years by several different companies but results have in general been disappointing.

CLEVELAND-CLIFFS IRON CO.—Contrary to expectations, it is announced that this company will not develop its Erickson property in the Iron River district for the present, but will devote its attention in Iron County to exploration in the Crystal Falls district. It is planned to ship 3,000,000 tons of iron ore from the company's Marquette and Mesabi range mines during 1913.

MISSOURI

Joplin District

PORTLAND LEAD & ZINC CO.—This company is planning the erection of a mill on the Cunningham estate adjoining the American Zinc, Lead & Smelting Co.'s property at Prosperity.

NAVAJO—A 100-ton concentrating plant is being built at this mine on a lease of the Taylor land north of Joplin. The mill equipment is being moved from an adjoining lease. Ore assaying 10% zinc blende is reported to be blocked out.

COSSEY & BROWN—These operators are planning a mill for a 20-acre lease of the Wilson Mines Co. at Duenweg. The lease is a portion of the old East End Mining Co. lease. The ore has formerly been hauled to a custom mill at Joplin, where 4% recovery was obtained.

HELEN C—This mine on a lease of the Alamo land at Thoms Station has been making large turn-ins from a more than usually rich deposit. Drainage is a problem because of the influx of water from cave-ins and open pits of old workings to the north.

TOM C—Operations have been suspended at this mine by T. C. Coyne, the operator. The mine has been a prolific producer during its brief existence, but the ore is now practically worked out. The mill will remain idle temporarily and will later be moved to another property.

WHITSETT—The mill at this mine was destroyed by fire, Apr. 12. The fire followed a collapse of the grizzly over the mill hopper which killed one man and injured two others. It is thought the fire originated from the crossing of power transmission wires. The mill will be rebuilt.

AMERICAN, ZINC, LEAD & SMELTING CO.—No. 3 shaft has been closed temporarily while repairs are made at both mine and mill. Three new jigs of the Cooley type will replace three old ones in the mill which handles 1000 tons per day. Under ground more than 1000 ft. of 6-in. air line is being laid with laterals of 4-in. pipe from which air is to be tapped to the 25 machines in the headings. Motor haulage is also being installed in the west half of the mine. This necessitates the replacement of the 14-in. gage track formerly used by 30-in. gage and heavier rails. It is estimated that it will be at least two weeks before the mine is again ready for operation.

MONTANA

Butte District

BUTTE-MINNESOTA—Work has been started in sinking a shaft on the property about four miles southwest of Butte. It will be sunk to the 200-ft. level, where a station will be cut and crosscutting started north and south to intersect several veins which outcrop on the surface.

EAST BUTTE—The year 1912 was the most prosperous in the history of the company, the production of refined copper, and net earnings, being greater than for any preceding year. As a result of the increased wages paid, there was an increase of 0.230c. in the cost per lb. of copper produced, making the total cost per lb., 9.698c., as against 9.46c. in 1911. The company sold its copper at an average price of 16.698c. per lb. Net earnings amounted to $982,701, as against $256,643 in 1911. The work of enlarging the furnaces at the Pittsmont smeltery, is expected to begin about May 1. One furnace at a time will be remodeled. With the completion of these improvements the combined capacity of the two furnaces will be about 2,000,000 lb. of copper per month. The shaft is nearing the 1500-ft. level, and will be sunk to the 1800-ft. The ore being mined at present comes from the 800- 1000- and 1200-ft. levels.

Deer Lodge County

EMERY—A lease and bond has been secured by Butte men on this property, situated seven miles east of Deer Lodge. The mine has produced a considerable tonnage of gold, silver and lead ore in the past and will probably be reopened soon.

STANDARD—Ore was recently struck on this claim, one of a group of eight claims owned by W. R. Allen and associates, and situated in American Gulch about 18 miles from Anaconda. The strike was made on the 100-ft. level, the ore containing copper, silver and gold. As soon as the roads are in good condition it is planned to begin wagon shipments to the Washoe smeltery.

Silver Bow County

A PLACER IN HIGHLAND GULCH 20 MILES SOUTH OF BUTTE has been located by Ira Petty and others of Butte. They will begin operations in the near future.

NEVADA

Comstock Lode

SIERRA NEVADA—At the couth side of the raise above the 2500-ft. level, 64 ft. above the sill-floor track, a fault was found to cut the ore off abruptly, and a southwest crosscut was started to cross the fault. The top of the raise is in rich ore.

COMSTOCK PUMPING ASSOCIATION—Engineer Walsh has been instructed to prepare plans and estimates of construction for an electric-power plant on the Sutro tunnel level of the C. & C. shaft, utilizing the 200 miners' inches of water formerly used on the hydraulic pumps. Fully 800 hp. could be developed in this way.

C. & C.—Two temporary turbine pumps have been placed in the shaft at the 2500 station, and the third pump has been removed from the south compartment to enable using that compartment for hoisting. The station at the 2500 is being repaired and work will be started immediately clearing the drainage drift connecting with the old joint Ophir-Mexican winze, at the head of which a turbine pump will be placed.

Lincoln County

DAY-BRISTOL—About half the force is working on development work and shipments have been curtailed The production is about 1000 tons of copper ore monthly. It is quite probable that this tonnage will be increased soon by lessees.

PRINCE CONSOLIDATED—Shipments approximate 10,000 tons monthly of manganiferous ores from the mine, in addition to tailings from Bullionville. Development work at the mine is being carried on with a diamond drill from the 500 or water level, in the hope of opening the high-grade fissure vein from which the manganese bed seems to have derived its valuable constituents. When the tailings pit at Bullionville is exhausted, a spur track about one mile long will be built to the Dry Valley tailings, also owned by this company.

Lyon County

NEW YERINGTON—This property is being developed on the 100- 300- and 400-ft. levels.

BLUE JAY—Development on this property, which is under option to the Gunn-Thompson interests, is proving satisfactory.

KEYNOTE GROUP—Half interest in this property southeast of Yerington was sold recently by C. C. Young to R. L. Merritt, of Butte, Mont.

BLUE STONE—Experiments by the magnetic concentration process have been very successful, a close saving of the copper minerals having been made. It is understood thata concentrator will be erected in the near future.

MASON VALLEY MINES CO.—Ore received at the smeltery, at Thompson, for the week ended Apr. 10, was as follows: From Mason Valley mine, 3092 tons; from Nevada-Douglas mine, 1651; and from other mines, 172; a total of 4915 tons; a daily average of 702 tons. For the same week seven cars of matte were shipped from the smeltery.

Nye County

JIM BUTLER—The vein beyond the fault on the sixth level, which threw it 60 ft. to the south, has been found again and the drift on the vein is now in good ore.

NORTH STAR—A shoot of shipping ore has been opened on the 900-ft. level. It is believed to be the eastern extension of the Macdonald vein in the Montana-Tonopah mine.

TONOPAH MERGER—A flow of water estimated at 100,000 gal. per day encountered on the 1170-ft. level has caused temporary suspension of operations until a pumping plant is installed. An Aldrich triplex pump has been purchased and will soon be in operation.

SHIPMENTS in tons from Tonopah mines for the week ended Apr. 19, were as follows:

Tonopah Mining	3100	North Star	....
Tonopah Belmont	3687	Mizpah Extension	....
Montana-Tonopah	1017	Jim Butler	400
Tonopah Extension	1075	Tonopah Merger	....
West End	975		
Midway	50	Total	10,872
MacNamara	568	Estimated value	$238,487

White Pine County

ANOTHER GENERAL STRIKE IS BEING TALKED ABOUT, to be called May 1, but after the experience of last autumn it is doubtful if the men can be induced to go out.

TWO DISCOVERIES OF TUNGSTEN ORE have been made recently. One discovery was of scheelite, the other of wolframite.

SMOKEY DEVELOPMENT—High-grade ore has been cut in the tunnel being driven toward the contact. Some of the ore contains 11% copper.

NEW MEXICO

Colfax County

A DREDGE AT ELIZABETHTOWN built in 1901 and operated four seasons recovered $200,000, became involved in litigation and was recently acquired by Charles Springer, of Cimarron, who would sell or lease it. There is a large field, about 2000 acres, that has been worked in a primitive way for 30 years. The gold seems to have come from innumerable veinlets and the black sand caught in the boxes assays from $120 to as high as $6000. Could some way be devised to save a portion of this it would pay well, as the total value of the black sand far exceeds that of the gold recovered. The average yield has been 11c. per cubic yard.

PAYORA—At this claim southwest of Elizabethtown two men have been drifting on a small vein of copper ore.

MAXWELL LAND GRANT CO.—This company owns about 300,000 acres of coal land and as much more mineral land. On the coal portion five mines are producing about 5000 tons per day; there are two coal washeries and 400 coke ovens in operation. The mineral land shows some good prospects and about$2,000,000 has been produced from placers and as much more from lodes. There are authentic records of $700,000 production from the Aztec, an old mine situated geologically at the top of the Pierre shale. It has been idle for years. Two years ago prospecting in a small way was begun. Four tunnels were driven about 80 ft. apart, vertically; the highest was 100 ft. lower than the lowest old workings. About 5000 tons of ore has been milled, yielding about $12 per ton. There is 2000 tons of ore in the dump and a quantity in sight in the mine. The ore occurs near the contact of quartzite and shale or within the quartzite. In view of the promising showing it is the intention to put in 10 more stamps there having been 10 stamps only dropping so far, and ore bins and a tramway will be built at the upper tunnel . A small compressor plant will be installed in the near future.

Socorro County

TRI-BULLION SMELTING & DEVELOPMENT CO.—This company is operating the Nit and Kelly mines.

ERNESTINE—The company is setting up a 260-hp. De La Vergne crude-oil engine, which will be belt-connected to a 150-kw. Westinghouse generator. Each half of the base of the engine weighs nine tons. The flywheel weighs 13 tons. These pieces, like all other machinery, were hauled out 90 miles from Silver City on wagons. A foundation has also been prepared for an Ingersoll-Rand compressor of 800 cu.ft. displacement per min. The compressor is now on the road. The power plant consists of a 180-hp. De La Vergne twin engine direct connected to a 125-kw. Westinghouse generator, and a single engine of the same make direct connected to an Ingersoll-Rand compressor of 550-cu.ft. displacement. With the new engines in place it is intended to tear out the old steam mill engine and boilers and put in a few additional tanks and make other improvements which will increase the capacity and efficiency of the mill.

OREGON

Clackamas County

OGLE MOUNTAIN—Preparations are being made for the installation of a cyanide plant at this mine. J. B. Fairclough, Oregon City, is in charge.

Josephine County

SUGAR PINE—This property has been taken under lease and bond by Fenn and associates, who are sinking on the lower level and are down 45 ft., having encountered high-grade gold- and silver-bearing galena.

Malheur County

DREXEL—It is reported that this property is to be opened again in the near future.

RED, WHITE & BLUE—A recent test of ore from this property which is being operated by D. K. Worsham and others, of Malheur, shows satisfactory results. Six stamps are dropping, and the plant will be enlarged.

SOUTH DAKOTA

St. Lawrence County

GOLDEN REWARD—Tests are being made in treating the product of the roaster built at the Astoria mine last winter. The results so far are encouraging, but indicate that some slight changes will be necessary in the roast in order to secure the best returns. At present the furnace is idle, but will soon be in operation.

BLACK HILLS CONSOLIDATED MINES—Negotiations for financing this group of claims adjoining the Homestake on the south are now under way in New York. A shaft 1000 ft. deep has been sunk on these claims and it is proposed to explore by drilling from the bottom with the expectation of cutting the extension of the Homestake lode which, it is surmised, will be found at a depth of about 1700 ft. The property is extensively equipped and the company is the merger of the Oro Hondo and Homestake South Extenson companies. Andrew H. Olsen is president. Several of the labor unions of the West have been associated in financing the work on these properties and have been interested in them as an investment for the union funds.

UTAH

Juab County

TINTIC SHIPMENTS FOR THE WEEK ENDED APR. 11 amounted to 189 cars.

LEHI TINTIC—Shipments have been started.

MINERAL RANGE—Work is to be resumed at this property by Salt Lake men.

GRAND CENTRAL—A quarterly dividend of 5c. per share has been declared, payable Apr. 25.

BEAVER BUTTE—A crosscut from the bottom of the 30-ft. shaft recently cut a quartz vein carrying gold.

IRON BLOSSOM—A quarterly dividend of 10c. per share amounting to $100,000 has been declared, payable Apr. 25.

SHEEP ROCK—Electric hoisting equipment and a compressor have been received, and will be installed at once. It is intended to increase the capacity of the mill, which is reported to be doing good work. Some high-grade ore has recently been found on the 110-ft. level.

MAY DAY—The annual report showed $13,370 cash on hand Mar. 31, 1913, as compared to $67.50 a year previous. Dividends amounting to $24,000 were paid. Receipts from ore sales amounted to $110,614, of which $90,113 came from zinc shipments, and $20,500 from lead ore. There were shipped 5499 tons of zinc ore, and 2649 tons of lead ore. Disbursements amounted to $97,866.

HORN SILVER—The annual report for 1912 shows receipts for ore to have been $120,543; royalties received from lessees, $17,031, and other income $13,407, making total receipts of $150,981. Expenses amounted to $126,465, leaving a balance of $24,515. After deducting New York office expenses, etc., there was a net profit of $8606. About $20,000 was spent for repairs for the shaft and machinery, made necessary by a cave-in. at the mine last October. Development totaling 1433 ft. was done. One new lead stope and two new zinc stopes were opened in the southern part of the

property. Shipments and settlements with the International Smelting & Refining Co. having a total value of $6216 are not included in the above figures.

Summit County

PARK CITY SHIPMENTS FOR THE WEEK ENDED APR. 4 amounted to 1050 tons, and those for the week ended Apr. 11 to 1668 tons. Total shipments for March were 5733 tons, which is less than the average on account of poor haulage conditions. During the first quarter of the year 20,423 tons were shipped.

MINES OPERATING CO.—This company, which has a lease on the upper levels of the Ontario property, is increasing the capacity of its mill.

SILVER KING COALITION—A dividend of 15c. per share amounting to $137,500 was paid Apr. 15. Total dividends to date amount to $13,022,385 by the present company and its predecessor, the old Silver King Mining Co.

Tooele County

CLIFF—This company, at Ophir, has resumed work in the Tony winze between the 700- and 800-ft. levels. Drifting will be started when the latter level is reached.

WASHINGTON

Ferry County

NORTH STAR—Operations at this property in the Orient district are to be resumed. Diamond drills will be used.

Okanagan County

OKANAGAN FREE GOLD—Operations are to be resumed at this mine near Oroville. A vertical shaft will be sunk and a compressor plant installed.

Skagit County

SWIFT CREEK—This placer property near Baker, owned by Joseph Morovitz, has been sold to a new company represented by Allen R. Moore.

Stevens County

MEYERS FALLS—This company will be in position to supply electric current to the mine operators in the Chewelah district, about June 1.

HECLA COPPER-SILVER—This company has recently been incorporated to develop a group of copper claims near Chewelah. Operations will start at once. John C. Argall, Spokane, is in charge.

CANADA

Ontario

GRACE—This gold mine in the Michipicoten district is under option to New York men and an examination will be made soon. The property is extensively developed and is equipped with a mill.

MENES—Negotiations for the sale of this gold property at Webbwood in western Ontario are under way. It is controlled in Detroit. Extensive development has been done, but the mine has been idle for several years. It is claimed that besides gold the ore also contains platinum in commercial amounts.

MAGNESIA PRODUCTS, LTD.—This company has been formed at Montreal to develop a deposit of magnesite at Calumet in Argenteuil County, near Montreal. The material will be shipped to Newark, N. J., where a plant is being built to calcine and to prepare the product for the market. The managing director is J. R. Colby of Montreal. The property has been examined by Dr. J. T. Donald and Fritz Cirkel. It is claimed that there are extensive bodies of good-grade magnesite in the region. Other companies are planning operations.

Ontario-Cobalt

BEACON CONSOLIDATED—It has been decided to sink the main shaft to a depth of 500 ft.

COBALT SILVER LEAF—Work has been resumed on this property by the Crown Reserve company. Milling ore is being developed on the 460-ft. level.

BEAVER—A 3-in. vein of high-grade ore has been cut on the 700-ft. level. This is the deepest point in Cobalt at which high-grade ore has been found. The annual report shows the production for 1912 to have been 689,921 oz., valued at $409,212, as compared with 750,950 oz. valued at $750,950 for 1911. The amount of silver in the ore on the dump and broken ore in the mine is estimated at 775,000 oz. No estimates are made of the ore in reserve.

SHIPMENTS of ore and concentrates in tons, from Cobalt mines for March, were as follows:

Bailey	89.17	Kerr Lake	90.96
Beaver	21.65	La Rose	259.00
Buffalo	....	Lost and Found	....
Casey Cobalt	51.00	McKinley-Darragh	160.80
Chambers-Ferland	64.00	Nipissing	360.21
City of Cobalt	....	Nipissing Reduction	....
Cobalt Lake	64.54	O'Brien	32.65
Cobalt Townsite	183.90	Penn.-Canadian	....
Colonial	....	Provincial	....
Coniagas	127.60	Right of Way	31.64
Crown Reserve	50.08	Seneca Superior	71.13
Dominion Reduction Co.	96.40	Silver Bar	....
Drummond	61.56	Silver Queen	29.75
General Mines	....	Timiskaming	59.92
Green Meehan	....	Trethewey	41.80
Hargraves	....	Wettlaufer	61.70
Hudson Bay	32.30		
		Total	2041.76

Ontario-Porcupine

WOODWARD MURRAY—English interests have taken a working option on these Kirkland Lake properties.

JUPITER—It is expected that orders for the new equipment will be placed soon. The main shaft will be sunk to the 500-ft. level and it is expected that the mill will be in operation this autumn. On the 300-ft. level, the main oreshoot has been opened for more than 400 feet.

MEXICO

Chihuahua

ALVARADO CONSOLIDATED MINING & MILLING CO.—Considerable development work has been done recently and a new shoot of rich ore has been opened on the sixth level. The largest production since the construction of the new mill was made in January.

SAN PATRICIO—This mine, at Parral, has been sold to a syndicate controlled by Bernard MacDonald and work on a 300-ton cyanide plant has been begun. This is an old mine which has produced extensively both shipping and milling ore. The chief yield is silver.

MAGISTRAL—Work has been continued on this property in the Indé district by the reorganized company. Development has now reached the seventh level and will be continued to the eighth level. A contract has been let for an experimental treatment plant which will be ready by July 1. W. L. Curry, of Pittsburgh, is president.

BATOPILAS MINING CO.—At a recent meeting it was decided to wind up the affairs of the British company of this name, and to reduce the capitalization from $9,000,000 to $4,500,000. The cut in capital will probably be accomplished through reduction in the par value of the stock from $20 to $10. The preliminary report of 1912 operations showed net profits of $81,202, against a deficit of $17,409 for 1911. High-grade ore forms but a small portion of the total yield and last year averaged 400 oz. of silver per ton, while the low-grade ore contained about 8 oz. of silver. For the last 18 months the product of the mines has been shipped to Liverpool, instead of to the Balbach refinery as formerly, with the result that a little better price was obtained for the silver. During the first quarter of 1913, the company produced 161,000 oz. of silver.

ESMERALDA—The deep development in this mine is of much interest to Parral miners as it indicates persistence of ore at depth and below the levels from which most of the ore has thus far come. The work, which has been under way for about six years, was for a time directed to the development of the low-grade ore found above the 500-ft. level. The deeper exploration was made with the idea of continuing the opening of the low-grade ore, but the result was the disclosure of a definite horizon of enriched ore at and below the 500-ft. level which subsequent exploration has indicated is extensive. In many of the other mines of Parral work has been discontinued at or in the low-grade zone and now there is an inducement to go to depth for this deep horizon. The Esmeralda company was financed by Fairman & Co., of Philadelphia. Wade Armstrong, formerly of Cananea, is in charge.

Jalisco

CANDELARIA—The option on this property at Ahualuco, which was held by J. B. Shale and associates of New York, has lapsed and the property is now controlled by Stanton N. Tiernan, of Baltimore, the former owner. The Candelaria Extension has also reverted to E. L. Porch, of San Antonio, Texas. Considerable work was done in the development of these properties and the adjoining Fortuna group by the optioners. The properties are not far from the Amparo mine and are reported to have yielded rich silver ore during former operations.

PACIFIC SMELTING & MINING CO.—The plans of this New York company to resume the operation of the smeltery at Fundicion have been delayed on account of the revolution. It is expected that smelting will begin as soon as conditions will permit and arrangements are being made to secure a supply of ore from California for iron and sulphur needed in smelting the siliceous ores.

MUCHACHO GRANDE—This silver-lead property on the Mayo River, about 60 miles north of Alamos, which was developed by Woodworth & Layne has been acquired by the Jutte estate interests of Pittsburgh, Penn., by the purchase of the stock of the Big Boy Mining Co., which held control. Work has been suspended until civil conditions are better, when it is proposed to continue development and to build a mill.

SOUTH AMERICA

British Guiana

AREMU GOLD MINING CO.—According to reports Lindley Vinton has won his suit against this company and is now in possession of the property, the mill and equipment. The company was promoted by Gaylord Wiltshire, of New York and Los Angeles and was largely financed among the socialist followers of Wiltshire. About two years ago the promotion was the subject of an investigation by the United States postal authorities, but no prosecutions followed. Wiltshire at the time moved to England and has since been active from there in this and other promotions. The Wiltshire interests also control the Bishop Creek gold mines in Inyo County, Calif., and it is reported that these properties are now being successfully operated.

Chile

BRADEN COPPER CO.—Stephen Birch, vice-president of the company, recently stated, upon his return from the property, that about 4000 men are employed. The railroad from Rancagua to the mines, 72 km. long, which is owned by the company, has been well ballasted and put in excellent condition. All the power used in the mining and milling operations is developed by the Cachapoal River, and the company owns one of the best power sites and plants in Chile. Operations at the new mill and the old mill are being carried on with the ordinary wet method of milling, the slime being treated by the Minerals Separation process. A plant for fine grinding is now being built, and upon its completion will treat 3000 tons of ore per day. It is also planned to smelt the concentrates on the property, and a smeltery for this purpose is now nearing completion.

Venezuela

PELL & CO., of NEW YORK, IS INVESTIGATING THE COAL DEPOSITS of Venezuela and intends extensive exploitation of those that can be operated. Iron deposits are also being examined in Colombia as well as Venezuela, and plans are being made to establish an iron industry on the shores of the Carribean.

THE MARKET REPORT

METAL MARKETS

NEW YORK—April 23

The metal markets generally show only moderate activity. Copper is a little easier, but in most other lines prices are inclined to firmness.

Copper, Tin Lead and Zinc

Copper—Moderately active business was done during the early part of the week, chiefly with European buyers. Consumers in Connecticut appear to be well suplied and consequently did not figure much as buyers. Sales to Europe were made on terms netting about 15.45@15.50c., New York. In the latter part of the week the market became very dull, and agencies that desired to effect sales freely offered copper at 15.40c., cash, New York, without, however, attracting much of any business. Many of the agencies have been asking 15¾c., delivered, usual terms, but the market has not become established on that basis, and such sales as have been reported at that price appear to have been for delivery in the noncompetitive Western markets figured up to New York parity. At the close the market is easy at 15.65@15.75c. for Lake copper and 15.35@15.45c. for electrolytic. Casting copper is quoted nominally at 15.25@15.35c. as an average for the week.

The standard market has been under pressure throughout the week, and the close is weak and lower at £67 12s. 6d. for spot, and £67 17s. 6d. for three months.

Base price of copper sheets is 21@22c. per lb. Full extras are charged, and higher prices for small quantities. Copper wire is 16½c. carload lots at mill.

Copper exports from New York for the week were 7060 long tons. Our special correspondent gives the exports from Baltimore at 2177 tons for the week.

Visible stocks of copper in Europe on April 15 are reported as follows: Great Britain, 23,050; France, 3800; Rotterdam, 5500; Hamburg, 5040; Bremen, 2346; total, 39,736 long tons, or 89,008,640 lb. This is an increase of 816 tons over the stocks on Mar. 31. In addition there is reported 2550 tons afloat from Chile and 3500 tons from Australia, bringing the total up to 45,786 tons.

Tin—Under the leadership of interests that have hitherto been known as bears in the London market, but which seem to have turned bulls, the market last week became very strong and prices advanced vigorously. When orders that were expected from this country failed to make their appearance, this advance was not maintained. Consumers in this market have all along been unwilling to follow the advance in London and offers at about half a cent below the importation price have not tempted them to make purchases. The market closes steady at £227 15s. for spot, and £223 5s. for three months, and at about 49½c. for April tin here.

Lead—It would seem that various buyers had advance information as regards the intention of the leading sellers to raise their price, for business became active all of a sudden and large orders were placed up to Apr. 22, when the American Smelting & Refining Co. announced that its schedule has been fixed at 4½c. New York, as against the previous price of 4.35c. New York. The close is steady at 4.32½@4.37½c. St. Louis, and 4.50c. New York.

After experiencing a violent decline, which amounted to £1 10s. from the high point, the quotations in London are again firm and higher on rumors of a coal strike in Australia which is likely to affect the production there. The close is strong at £18 for Spanish lead, and 7s. 6d. higher for English.

Spelter—The pressure to sell continues, and in spite of the extreme decline which has taken place consumers so far do not feel disposed to take hold on a liberal scale but confine their purchases to a hand to mouth policy. There has been a further decline, and the close is easy at 5.35@5.45c. St. Louis, and 5.50@5.60c. New York.

The strike at the Meadowbrook works of the Grasselli Chemical Co. has been a market factor of some consequence.

The London market is somewhat higher at £25 10s. for good ordinaries, and £25 17s. 6d. for specials.

Base price of zinc sheets declined ¼c. on Apr. 22, and is now $7.75 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

On April 14 a consignment of 305 tons zinc ore was received at Baltimore from Antwerp, Belgium.

Other Metals

Aluminum—The market has dropped back into quiet and business has been rather slow. Prices are nominally unchanged, 26¾@27¼c. per lb. being asked for No. 1 ingots, New York.

Antimony—Business has been very quiet. Prices are a little easier. Cookson's is unchanged at 9@9.25c. per lb., but other brands off, Hallett's being sold at 8.35@8.50c. per lb., while 7.75@8c. is named for Chinese, Hungarian and other outside brands.

Quicksilver—The market is still rather quiet with prices inclined to be easy. New York price is $39 per flask of 75 lb., with 58c. per lb. for small lots. San Francisco, $38.50 for domestic orders and $36 for export. The London price is £7 10s. per flask, with £7 2s. 6d. named from second hands.

DAILY PRICES OF METALS

NEW YORK

Apr.	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
17	4.8640	59⅜	15⅝ @15¾	15.45 @15.50	50¼	4.35	4.22½ @4.25	5.55 @5.65	5.40 @5.50
18	4.8625	59¾	15.65 @15.75	15.45 @15.50	50⅛	4.35	4.22½ @4.25	5.55 @5.65	5.40 @5.50
19	4.8635	59⅝	15.65 @15.75	15.45 @15.50	50	4.35	4.22½ @4.25	5.55 @5.65	5.40 @5.50
21	4.8635	59¾	15.65 @15.75	15.35 @15.45	49⅝	4.35	4.22½ @4.25	5 50 @5.60	5.35 @5.45
22	4.8650	60	15.65 @15.75	15.35 @15.45	49½	4.40 @4.50	4.30 @4.35	5.50 @5.60	5.35 @5.45
23	4.8670	60⅛	15.65 @15.75	15.35 @15.45	49½	4.50	4.32½ @4.37½	5.50 @5.60	5 35 @5.45

The quotations herein given are our appraisal of the market for copper, lead spelter and tin based on wholesale contracts with consumers without distinction as to deliveries; and represent, to the best of our judgement, the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic. We quote casting copper at 0.15c. below the price for electrolytic. The quotations for lead represent wholesale transactions in open market for good ordinary brands, both desilverized and non-desilverized; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

Apr.	Silver	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
		Spot	3 Mos	Best Sel'td	Spot	3 Mos		
17	27⅜	69¼	69 5/16	75	229½	224⅛	18⅜	25½
18	27 5/16	68¾	68 13/16	75	230½	225¾	18¼	25½
19	27½	....	....	....	....	....	....	....
21	27 5/16	67 5/16	67¾	74	228¼	223¼	17¼	25½
22	27 11/16	67 13/16	68 5/16	74	227½	223½	17¾	25¾
23	27¼	67⅝	67¼	74	227½	223¼	18	25¼

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. ,except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, pot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c.; = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 21¾c.

Nickel—Shot, block and plaquettes are quoted at 40@45c. per lb., according to quality and size of order. Electrolytic nickel is 5c. per lb. higher.

Cadmium—The latest quotation from Germany is 725@750 marks per 100 kg. f.o.b. works in Silesia. This is equal to 78.27@80.97c. per lb. at works.

Selenium—Producers of this metal quote large lots at $2.75@3.50 per lb., according to size of order; while as high as $4.50@5.50 is paid for retail lots.

Exports from Baltimore for the week ended April 21 included 1874 lb. selenium to Hamburg.

Gold, Silver and Platinum

Gold—The price of gold on the open market in London continued at the Bank level, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. The German demand seems to be satisfied for the present and most of the supplies arriving went to the Bank of England.

Gold and silver movement in the United States, three months ended Mar. 31:

	Gold		Silver	
	1912	1913	1912	1913
Exports	$19,958,086	$47,687,641	$16,955,988	$17,288,480
Imports	12,414,195	15,947,824	11,850,210	9,865,791
Excess, exp.	$7,543,891	$31,739,817	$5,105,778	$7,422,689

Exports of merchandise for the three months in 1913 were valued at $608,384,431; imports at $468,440,356; excess of exports, $139,944,075. Adding gold and silver makes a total export balance of $507,602,862 this year.

Imports of gold into Great Britain three months ended Mar. 31 were £11,597,201; exports, £11,108,514. Excess of imports, £488,687, against £717,113 last year.

Iridium—Demand continues up to supply, and dealers still ask $85 per oz., New York.

Platinum—Business is good and the market is steady and unchanged. Dealers ask $45@46 per oz. for refined platinum, according to size of order. Hard metal—platinum-iridium alloy—is $49@53 per oz., according to proportion of iridium.

Our Russian correspondent writes, under date of Apr. 10, that the market is steady, and higher prices are expected by the large dealers. The stocks are small and are in strong hands. The offers of new metal by the starateli are insignificant so far. It is probable that the operations of the starateli will be reduced, as some of the owners of the placer lands intend to work them on a larger scale for their own account, instead of letting them to tributers. Current prices are unchanged, being 9.70 rubles per zolotnik at Ekaterinburg and 37,700@37,800 rubles per pood at St. Petersburg—equal to $36.47 and $37 per oz.—for crude metal, 83% platinum.

The latest figures received put the total production of platinum in Russia during the year 1912, at 337.2175 poods, equal to 255,112.92 oz. troy.

Silver—The market has shown some disposition to advance. Prices in India are lower than the London prices, but the presumption is that the London market has advanced on buying by China banks.

Exports of silver from London to the East, Jan. 1 to Apr. 10, reported by Messrs. Pixley & Abell:

	1912	1913	Changes
India	£1,925,800	£2,501,300	I. £575,500
China	520,000	166,000	D. 354,000
Total	£2,445,800	£2,667,300	I. £221,500

Exports of silver from New York, week ended Apr. 19, were $1,279,393, chiefly to London and Paris; imports were $157,240, chiefly from South America.

Zinc and Lead Ore Markets

JOPLIN, MO.—Apr. 19

The high price of zinc blende is $47, the base range $42@44 per ton of 60% zinc. Calamine is $19@20 per ton of 40% zinc. The average of all grades is $40.54. Lead was in demand at a lower offering of $1 per ton, the high being $53.50, the base $52.50 per ton of 80% metal contents; the average of all grades is $52.22 per ton.

SHIPMENTS, WEEK ENDED APRIL 19

	Blende	Calamine	Lead ore	Value
Totals	12,140,740	761,750	2,055,450	$315,266
16 weeks	169,690,200	11,210,220	30,273,880	4,980,633

Blende value, the week, $252,451; 16 weeks, $4,024,335.
Calamine value, the week, $9127; 16 weeks, $156,682.
Lead value, the week, $53,688; 16 weeks, $799,616.

PLATTEVILLE, WIS.—Apr. 19

The base price paid this week for 60% zinc ore was $40@44. The base price paid for 80% lead ore was $52@53 per ton.

SHIPMENTS WEEK ENDED APRIL 19

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	1,811,660	50,800	1,452,640
Year to date	42,760,070	1,689,240	18,988,150

Shipped during week to separating plants, 2,098,830 lb. zinc ore.

IRON TRADE REVIEW

NEW YORK—Apr. 23

Very little is now to be noted in the iron and steel markets. The mills embarrassed by the recent floods are nearly all in good condition again and gradually working up to full production. There is still some trouble with transportation, and rail deliveries are slow.

The estimates of damage done by the floods in the West are being made up in definite shape. Of course, the total is not so great as at first estimated, but it is large enough. A good deal of steel will be needed for new bridge work and some for buildings.

The pig-iron market is still a little uncertain, but is inclined to harden, in view of the many inquiries for second half. It is evident that there will be a good demand for basic pig. The market is more active in Seaboard territory than in the West.

The United States Steel Corporation held its annual meeting Apr. 21, when the following director were reëlected for terms of three years: Alfred Clifford, E. C. Converse, James A. Farrell, E. H. Gary, J. P. Morgan, George W. Perkins and Henry Phipps. Thomas Murray, assistant secretary, was chosen temporarily to fill the vacancy caused by the death of J. P. Morgan. There was some discussion on the labor question, and also on the position of the government suits, but no action was taken.

British exports of iron and steel and manufactures thereof from Great Britain three months ended Mar. 31 were: Iron and steels, £13,321,611; cutlery, hardware, etc., £3,485,743; machinery, £8,590,063; new ships, £2,039,490; total, £27,436,907, an increase of £3,469,609 over last year. Imports were: Iron and steels, £3,967,789; cutlery, hardware, etc., £1,978,116; machinery, £1,833,892; total, £7,779,797, an increase of £1,270,290 over last year. Quantities of iron and steel exported, so far as given, were 1,287,091 long tons in 1912, and 1,175,691 tons in 1913. Quantities imported were 459,239 tons in 1912, and 583,158 tons this year.

The Make of Pig Iron in Germany in March is reported by the German Iron & Steel Union at 1,628,190 metric tons, being 135,679 tons more than in February. For the three months ended Mar. 31, the totals were, in metric tons:

	1912	1913	Changes
Foundry iron	774,301	891,631	I. 117,330
Forge iron	136,954	134,477	D. 2,477
Steel pig	514,945	639,815	I. 124,870
Bessemer pig	85,128	91,656	I. 6,528
Thomas (basic) pig	2,657,442	2,972,836	I. 315,394
Total	4,168,770	4,730,415	I. 561,645

The total increase this year was 13.5%. Steel pig includes ferromanganese, spiegeleisen and all similar alloys.

PITTSBURGH—Apr. 22

New contracts in finished-steel products are now very light indeed. Specifications against old contracts keep up fairly well, but are hardly as heavy this week as last, and show a definite decrease from the rate of 30 days ago. The mills are losing ground very slowly, however, and some not at all, with respect to business actually specified on books. As to contracts for forward delivery, the absence of active business is not seriously considered, since such contracts are worthless in any event unless specified against, so that attention is paid chiefly to the rate of specifying. Even with the less promising outlook now before the mills, full operation seems assured until midsummer, and any improvement in the sentiment of buyers over the present apathy, would easily result in enough business to carry the mills through the usually dull period at full gait.

Prices are being quite firmly maintained for finished-steel products, the only weakness, and it relatively insignificant, being in galvanized sheets, which are quoted by a few mills at 3.40c., a concession of $2 a ton. Steel pipe, on the other hand, is firmly maintained at the new schedule of Apr. 12, which carried an advance of about $1 a ton, whereas the old prices were being shaded by about $1 a ton.

Pig Iron—The market is almost absolutely stagnant, but, nevertheless, shows a disposition toward lower prices. Foundry iron has definitely declined, shown by the purchase yesterday of 1000 tons of standard No. 2 foundry iron by the Standard Sanitary Manufacturing Co., at $16, delivered Pittsburgh. This was at $15.15, furnace, from a furnace carrying an 85c. rate to Pittsburgh, as against the regular 90c. rate from the Valleys. Several Valley furnaces have quoted $15.25 at furnace, a decline of 25c. in theweek. Malleable is also quotably lower. The condition of the market is somewhat remarkable in view of the fact that stocks at merchant furnaces in the Valleys and western Pennsylvania have been decreasing, and are now at the lowest point for a long while. Consumption appears to be as heavy as formerly, the market trouble being simply that prices started downward and buyers will not take hold until they show some stiffness. We quote: Bessemer, $17; basic, $15.75; malleable, $15.50; No. 2 foundry, $15.25; forge, $14.75, f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh, except that foundry iron is quotable at $16@16.15, Pittsburgh.

Ferromanganese—The market is stagnant. There is no demand for prompt metal, and as all contracts carry a duty clause buyers do not care to take hold at the present figure, when they would have to pay the increase in duty contemplated by the present tariff bill, the increase amounting to about $6. We quote prompt and contract at $61, Baltimore, freight to Pittsburgh being $2 per ton.

Steel—Deliveries of semifinished steel on contracts are, if anything, worse than they were, and there is no new business. We continue to quote billets at $29; sheet bars and rods at $30, at maker's mill, Pittsburgh or Youngstown.

Sheets—There is hardly any forward buying, but specifications on contracts are very good, fully equaling current shipments. The leading interest is this week operating 75% of its sheet mills, being short of steel. Two or three independent sheet mills are quoting 3.40c. on galvanized, or $2 under the regular figure, being short of business through not having contracted some time ago as freely as did other mills. Current deliveries are against contracts at 3.40c. or lower, so that the cutting does not affect the general situation. We quote: Blue annealed, 1.75c.; black, 2.35c.; galvanized, 3.40@3.50c.; painted corrugated, 2.55c.; galvanized corrugated, 3.55c. per pound.

IRON ORE

The Sault is reported free from ice, and the first cargoes of Lake ore leave this week. There is a pressure for iron ore deliveries and transportation will be pushed.

The Kingston iron mine at Garrison, N. Y., in the Hudson River district, which has been idle for several years, is to be reopened by the Mount Summit Ore Co., which is the owner.

Imports of iron ore into Great Britain three months ended Mar. 31 were 1,609,648 long tons in 1912, and 2,041,904 in 1913; increase, 432,256 tons. Imports of manganese ore were 69,552 long tons in 1912, and 165,887 tons this year.

COKE

The coke market has been under severe pressure, but production in the Connellsville region did not increase last week. Transportation is not yet up to the mark and shortage of cars has kept down the output. Prices are strong, but buyers hesitate, because of the trouble about deliveries.

Coal and Coke Tonnage of Pennsylvania R.R. lines East of Pittsburgh and Erie, three months ended Mar. 31, short tons:

	1912	1913	Changes
Anthracite	3,288,737	2,743,504	D. 545,233
Bituminous	12,169,935	12,117,747	D. 52,188
Coke	3,111,786	3,756,325	I. 644,539
Total	18,570,458	18,617,576	I 47,118

The total increase this year was 0.25%. The gain was entirely in coke. Tonnage in March was diminished by flood conditions.

British Exports of Fuel, three months ended Mar. 31, were: Coal, 17,239,009; coke, 282,190; briquettes, 507,202; bunker coal for steamships in foreign trade, 4,951,231; total, 22,979,632 long tons, an increase of 5,804,805 tons over last year.

CHEMICALS

The general market is still rather quiet, and business is inclined to hold back.

Arsenic—The market continues dull, with very little business doing. Prices are unchanged at $3.90@4.12½ per 100 lb., but are rather nominal.

Copper Sulphate—Business is good, with fair sales. Prices are unchanged at $5.25 per 100 lb. for carload lots and $5.50 per 100 lb. for smaller orders.

Nitrate of Soda—The market is a little less active, but sales are fair. Prices are a shade easier, 2.60c. per lb. being paid for April, 2.57½c. for May, 2.55c. for June, 2.52½c. for July and 2.50c. for later deliveries.

PETROLEUM

Exports of mineral oils from the United States in March were 145,202,374 gal. For the three months ended Mar. 31 the total exports were 368,475,037 gal. in 1912, and 411,819,432 in 1913; an increase of 43,344,395 gal., or 11.8% this year.

COPPER SMELTERS' REPORTS

This table is compiled from reports received from the respective companies, except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept. of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield thereof is reckoned at 97%. In computing the total American supply duplications are excluded.

	Dec.	Jan.	Feb.	March
Alaska shipments	3,766,029	1,668,328	660,250	472,293
Anaconda	23,400,000	21,000,000	21,250,000	22,900,000
Arizona, Ltd	3,100,000	3,100,000	3,000,000	3,200,000
Copper Queen	8,805,568	7,554,966	6,810,706	7,558,709
Calumet & Arizona	5,840,000	4,750,000	4,050,000	.....
Chino	3,368,850	2,903,030	3,813,998	4,449,884
Detroit	2,389,875	1,769,071	1,689,277	1,640,671
East Butte	1,314,021	1,469,000	1,325,000	1,400,000
Mammoth	1,850,000	1,957,804	1,661,150	1,641,091
Giroux	625,000	650,000	.....	.....
Mason Valley	1,550,000	1,575,100	.....	.....
Nevada Con.	3,975,631	4,169,705	4,798,531	.....
Ohio	566,816	492,760	380,849	596,651
Old Dominion	2,727,000	2,727,000	2,381,000	2,853,000
Ray	3,638,500	3,610,000	3,610,000	4,287,400
Shannon	1,361,420	1,232,000	1,152,000	1,260,000
South Utah	*nil*	*nil*	*nil*	.....
United Verde*	3,000,000	2,900,000	2,750,000	.....
Utah Copper Co	5,676,484	7,182,495	7,585,303	8,248,880
Lake Superior*	18,300,000	17,500,000	19,000,000	19,000,000
Non-rep. mines*	7,750,000	7,500,000	7,000,000	8,000,000
Total production	103,005,194	95,711,259	.....	.....
Imports, bars, etc	28,761,087	34,026,236	.....	.....
Total blister	131,766,281	129,737,495	.....	.....
Imp. in ore and matte	10,385,662	7,563,758	.....	.....
Total American	142,151,943	137,301,253	.....	.....
Miami†	2,913,840	2,932,369	2,817,200	3,102,200
Shattuck-Arizona	.....	1,381,422	1,136,480	1,234,450
Brit. Col. Cos.:				
British Col. Copper	.....	.....	.....	.....
Granby	.....	1,792,245	1,740,000	1,967,962
Mexican Cos.:				
Boleo†	2,480,240	2,658,880	2,535,680	2,204,720
Cananea	5,592,000	.....	4,880,000	4,772,000
Moctezuma	2,793,781	2,913,294	2,730,914	3,062,159
Other Foreign:				
Braden, Chile	910,000	1,484,000	1,178,000	1,472,000
Cape Cop., S. Africa	750,560	770,540	.....	.....
Kyshtim, Russia	1,489,600	1,644,160	1,352,960	.....
Spassky, Russia	974,400	974,400	1,003,520	.....
Exports from				
Chile	7,392,000	6,752,000	5,824,000	7,840,000
Australia	9,856,000	9,744,000	5,512,000	6,944,000
Arrivals in Europe‡	16,363,200	17,689,280	8,509,760	15,585,920

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
‡ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S. Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
III, '12	125,694,601	67,487,466	58,779,566	62,939,988	141,142,400	204,082,387
IV	125,464,644	69,513,846	53,252,326	62,367,557	136,819,200	199,186,757
V	126,737,836	72,702,277	69,485,945	695,066,02	134,176,000	199,242,029
VI	122,315,240	66,146,229	61,449,650	49,615,643	117,801,600	167,417,244
VII	137,161,129	71,094,381	60,121,331	44,335,004	108,186,000	152,521,003
VIII	145,628,521	78,722,418	70,485,150	50,280,421	113,299,200	163,579,621
IX	140,089,819	63,460,810	60,264,796	46,701,374	113,568,000	160,269,374
X	145,405,453	84,104,734	47,621,342	63,065,587	107,408,000	170,473,587
XI	134,695,400	69,369,795	55,906,550	76,744,964	103,801,600	180,546,564
XII	143,354,042	58,491,723	65,713,796	86,164,059	96,947,200	183,111,259
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
I, 1913	143,479,625	65,210,030	60,383,845	105,312,582	78,491,840	183,904,422
II	130,948,881	59,676,492	72,168,523	123,198,332	77,504,000	200,702,332
III	136,251,849	76,585,471	77,699,306	122,302,890	81,244,800	203,547,690
IV	.....	.....	.....	104,269,270	87,180,800	191,450,070

Note—From Jan. 1, 1913, visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq	Sale	Amt.
Atlas Wonder, Nev.	Apr. 21	May 14	$0.01
Benton, Ida.	Apr. 20	May 20	0.0025
Caledonia, Nev.	Apr. 9	Apr. 29	0.05
Cariboo, Ida.	Apr. 5	May 1	0.0½
Con. Imperial, Nev.	May 6	May 28	0.01
Con. Virginia, Nev.	Apr. 23	May 14	0.15
Eagle Mountain, Ida.	Apr. 19	May 17	0.000½
East Hercules Ext., Ida.	Apr. 15	.....	0.001½
Great Ruby, Calif.	Apr. 17	May 7	0.10
Gypsy Queen, Nev.	Mar. 31	May 5	0.01
Holy Terror, Ida.	Apr. 12	May 12	0.001
Hypotheek, Ida.	Apr. 15	May 10	0.005
Imlay, Nev.	Apr. 10	Apr. 29	0.01
Knickerbocher, Ida.	Apr. 24	.....	0.005
Lehi Tintic, Utah	Apr. 15	May 7	0.0½
Little Cottonwood, Utah	Apr. 17	May 8	0.0½
North Lake, Mich.	May 19	.....	1.00
O. K. Silver, Utah	Apr. 15	May 10	0.0½
Ophir, Nev.	Apr. 16	May 8	0.15
Samson, Ida.	Apr. 1	May 1	0.002
Santaquin Central, Utah	Apr. 21	May 31	0.005
Seg. Belcher, Nev.	Apr. 8	Apr. 29	0.052
Silver Shield, Utah	Apr. 10	May 1	0.002
Sunset, Ida.	Apr. 15	May 12	0.012
Tuscumbia, Ida.	Apr. 26	May 24	0.001
Wasatch, Utah	Apr. 19	May 24	0.01

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	53.795	56.260	62.938	24.865	25.887	28.983
February	52.222	59.043	61.642	24.081	27.190	28.357
March	52.745	58.375	57.870	24.324	26.875	26.669
April	53.325	59.207	.....	24.595	27.284	.....
May	53.308	60.880	.....	24.583	28.038	.....
June	53.043	61.290	.....	24.486	28.215	.....
July	52.630	60.654	.....	24.286	27.919	.....
August	52.171	61.606	.....	24.082	28.375	.....
September	52.440	63.078	.....	24.209	29.088	.....
October	53.340	63.471	.....	24.594	29.299	.....
November	55.719	62.792	.....	25.649	29.012	.....
December	54.905	63.365	.....	25.349	29.320	.....
Year	53.304	60.835	.....	24.592	28.042	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

	New York				London, Standard	
	Electrolytic		Lake			
	1912	1913	1912	1913	1912	1913
January	14.094	16.488	14.337	16.767	62.760	71.741
February	14.084	14.971	14.329	15.253	62.893	65.519
March	14.698	14.713	14.868	14.930	65.884	65.329
April	15.741	.....	15.930	.....	70.294	.....
May	16.031	.....	16.245	.....	72.352	.....
June	17.234	.....	17.443	.....	78.259	.....
July	17.190	.....	17.353	.....	76.636	.....
August	17.498	.....	17.644	.....	78.670	.....
September	17.508	.....	17.698	.....	78.762	.....
October	17.314	.....	17.661	.....	76.389	.....
November	17.326	.....	17.617	.....	76.890	.....
December	17.376	.....	17.600	.....	75.516	.....
Year	16.341	.....	16.560	.....	72.942	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1912	1913	1912	1913
January	42.529	50.298	191.519	238.273
February	12.962	48.766	195.036	220.150
March	12.577	46.832	192.619	213.645
April	43.923	.....	200.513	.....
May	16.063	.....	208.830	.....
June	45.815	.....	205.863	.....
July	44.519	.....	202.446	.....
August	45.857	.....	208.351	.....
September	49.135	.....	223.762	.....
October	50.077	.....	228.353	.....
November	49.891	.....	227.619	.....
December	49.815	.....	226.875	.....
Av. year	46.096	.....	209.322	.....

New York in cents per pound; London in pounds sterling per long ton.

LEAD

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	4.435	4.321	4.327	4.171	15.597	17.114
February	4.026	4.325	3.946	4.175	15.738	16.550
March	4.073	4.327	4.046	4.177	15.997	15.977
April	4.200	.....	4.118	.....	16.331	.....
May	4.194	.....	4.072	.....	16.509	.....
June	4.392	.....	4.321	.....	17.588	.....
July	4.720	.....	4.603	.....	18.544	.....
August	4.569	.....	4.452	.....	19.655	.....
September	5.048	.....	4.924	.....	22.292	.....
October	5.071	.....	4.894	.....	20.630	.....
November	4.615	.....	4.463	.....	18.193	.....
December	4.303	.....	4.152	.....	18.069	.....
Year	4.471	.....	4.360	.....	17.929	.....

New York and St. Louis cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	6.442	6.931	6.292	6.854	26.642	26.114
February	6.499	6.239	6.349	6.089	26.661	25.338
March	6.626	6.078	6.476	5.926	26.048	24.605
April	6.633	.....	6.483	.....	25.644	.....
May	6.679	.....	6.529	.....	25.790	.....
June	6.877	.....	6.727	.....	25.763	.....
July	7.116	.....	6.966	.....	26.174	.....
August	7.028	.....	6.878	.....	26.443	.....
September	7.454	.....	7.313	.....	27.048	.....
October	7.426	.....	7.276	.....	27.543	.....
November	7.371	.....	7.221	.....	26.804	.....
December	7.162	.....	7.081	.....	26.494	.....
Year	6.943	.....	6.799	.....	26.421	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON IN PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1912	1913	1912	1913	1912	1913
January	$15.12	$18.15	$13.32	$17.35	$14.00	$18.59
February	15.03	18.15	13.28	17.22	14.01	18.13
March	14.95	18.15	13.66	16.96	14.10	17.53
April	15.13	.....	13.90	.....	14.15	.....
May	15.14	.....	13.90	.....	14.12	.....
June	15.15	.....	14.11	.....	14.22	.....
July	15.15	.....	14.38	.....	14.38	.....
August	15.43	.....	14.90	.....	14.85	.....
September	16.86	.....	16.03	.....	15.63	.....
October	17.90	.....	17.18	.....	17.22	.....
November	18.07	.....	17.09	.....	18.00	.....
December	18.15	.....	17.45	.....	18.73	.....
Year	$16.01	.....	$14.93	.....	$15.28	.....

STOCK QUOTATIONS

COLO. SPRINGS Apr. 22

Name of Comp.	Bid.
Acacia	.02⅝
Cripple Cr'k Con.	.01
C. K. & N.	.11
Doctor Jack Pot	.07⅝
Elkton Con.	.58
El Paso	4.80
Findlay	.02⅜
Gold Dollar	.10½
Gold Sovereign	‡ .02
Isabella	.11⅝
Jack Pot	.05½
Jennie Sample	‡ .01
Lexington	‡ .008
Moon Anchor	‡ .005
Old Gold	.02⅞
Mary McKinney	.60
Pharmacist	.01
Portland	.98
Vindicator	.89
Work	‡ .004

SALT LAKE Apr. 22

Name of Comp.	Bid.
Beck Tunnel	.11
Black Jack	.08
Cedar Talisman	.02½
Colorado Mining	.14
Columbus Con.	.06
Crown Point	.03
Daly-Judge	5.50
Grand Central	.69
Iron Blossom	1.37½
Little Bell	‡ .35
Lower Mammoth	.03
Mason Valley	6.50
May Day	.11
Nevada Hills	1.12½
New York	‡ .01
Prince Con	.44
Silver King Coal'n	4.10
Sioux Con.	.03¾
Uncle Sam	.06
Yankee	.12

TORONTO Apr. 22

Name of Comp.	Bid	Name of Comp.	Bid
Bailey	.09½	Foley O'Brien	.28
Coniagas	8.00	Hollinger	18.50
T. & Hudson Bay	‡64.00	Imperial	.03
Timiskaming	.34	Jupiter	‡ .49
Wettlaufer-Lor.	.15	Pearl Lake	.56
Apex	‡ .02½	Porcu. Gold	.23
Crown Chartered	.00¾	Preston E. D.	‡ .04
Dobie	‡ 15	Rea	.29
Dome	‡17.50	Swastika	.10½
Dome Exten.	.10	West Dome	‡ .24½

SAN FRANCISCO Apr. 22

Name of Comp.	Clg.
COMSTOCK STOCKS	
Alta	.06
Belcher	.25
Best & Belcher	.02
Caledonia	‡1.60
Challenge Con.	.05
Chollar	.03
Confidence	.30
Con. Virginia	.18
Crown Point	.24
Gould & Curry	.02
Hale & Norcross	.04
Mexican	.75
Occidental	.70
Ophir	.19
Overman	.30
Potosi	.02
Savage	.03
Sierra Nevada	.22
Union Con.	.08
Yellow Jacket	.24

Name of Comp.	Bid
MISC. NEV. & CAL.	
Belmont	6.85
Jim Butler	1.10
MacNamara	.20
Midway	.52
Mont.-Tonopah	1.75
North Star	.36
West End Con.	1.55
Atlanta	.15
Booth	.04
C.O.D. Con.	.04
Comb. Frac.	.05
Jumbo Extension	.25
Pitts.-Silver Peak	.15
Silver Pick	.06
St. Ives	.30
Tramp Con.	‡ .01
Argonaut	2.00
Bunker Hill	1.50
Central Eureka	.20
So. Eureka	2.75

N. Y. EXCH. Apr. 22

Name of Comp.	Clg.
Amalgamated	77⅜
Am. Agri. Chem.	51
Am.Sm.&Ref.,com	70
Am. Sm. & Ref., pf.	103½
Am. Sm. Sec., pf. B	84½
Anaconda	38⅞
Batopilas Min.	1⅜
BethlehemSteelpf	70½
Chino	40¼
Federal M. & S., pf.	33
Goldfield Con.	2⅛
GreatNor.,ore,ctf.	36
Guggen. Exp.	47⅛
Homestake	100
Inspiration Con.	18
Miami Copper	24⅞
Nat'nalLead,com.	49
National Lead, pf.	105½
Nev. Consol.	17⅜
Phelps Dodge	200
Pittsburg Coal, pf.	83⅜
Ray Con.	18½
RepublicI&S,com.	25¾
Republic I & S, pf.	84
SlossSheffl'd,com.	30
Sloss Sheffield, pf.	90½
Tennessee Copper	36
Utah Copper	53¾
U. S. Steel, com.	62½
U. S. Steel, pf.	108⅝
Va.Car. Chem., pf.	108

N. Y. CURB Apr. 22

Name of Comp.	Clg.
Barnes King	1.19
Beaver Con.	.38
Braden Copper	8½
B. C. Copper	2¾
Buffalo Mines	2⅞
Caledonia	‡ .40
Con. Ariz. Sm.	⅛
Davis-Daly	2⅛
Diam'field-Daisy	.04
Ely Con.	.10
Florence	.47
Giroux	2⅛
Gold Hill Con.	‡1¾
Greene Cananea	7⅞
Greenwater	.04
Internat. S. & R.	‡117
Kerr Lake	3¼
Keystone	‡2
La Rose	2⅞
McKinley-Dar-Sa.	11⅝
Min. Co. of A. new	2½
Motherlode Gold.	‡.60
Nev. Utah M. & S.	‡ .01
Nipissing Mines	9
Ohio Copper	1
Pacific Sm. & M.	⅜
Puebla S. & R.	2⅛
South Live Oak	‡2
South Utah M. & S.	⅜
Standard Oil (Old)	1030
Stand'd Oil of N.J.	354
Stewart	1⅛
Tonopah	6
Tonopah Ex.	2¼
Tonopah Merger	.97
Tri-Bullion	⅜
Tularosa	⅝
Union Mines	⅛
United Cop., pfd.	3½
Yukon Gold	2⅛

BOSTON EXCH. Apr. 22

Name of Comp.	Clg.
Adventure	2
Ahmeek	310
Algomah	.90
Allouez	36
Am. Zinc	27¼
Ariz. Com., ctfs.	3½
Bonanza	.38
Boston & Corbin	6
Butte & Balak	2⅝
Calumet & Ariz.	66¾
Calumet & Hecla	476
Centennial	15
Cliff	1½
Copper Range	44½
Daly West	3
East Butte	12
Franklin	7
Granby	63½
Hancock	20⅝
Hedley Gold	31
Helvetia	¼
Indiana	13
Island Cr'k, com.	52
Island Cr'k, pfd.	85
Isle Royale	26
Keweenaw	2¾
Lake	13¼
La Salle	4
Mass	3⅞
Michigan	1¼
Mohawk	53
New Arcadian	1⅜
New Idria Quick.	3⅞
North Butte	30¼
North Lake	1¾
Ojibway	2
Old Dominion	48½
Osceola	88
Quincy	69
Shannon	11
Shattuck-Ariz.	23¾
Superior	31¾
Superior & Bost.	3¾
Tamarack	31
Trinity	4
Tuolumne	2⅜
U. S. Smelting	40¼
U. S. Smelt'g, pf.	48¼
Utah Apex	1½
Utah Con.	8½
Victoria	1
Winona	2½
Wolverine	61
Wyandot	1⅛

LONDON Apr. 22

Name of Com.	Clg.
Camp Bird	£0 18s 3d
El Oro	0 14 1
Esperanza	1 6 10
Mexico Mines	5 18 10
Oriental Con.	1 10 0
Oroville	0 5 9
Santa Gert'dis	1 4 8
Tomboy	1 4 2

BOSTON CURB Apr. 22

Name of Comp.	Last
Alaska Gold M.	13½
Bingham Mines	3¾
Boston Ely	.65
Boswyocolo	‡ .01
Butte Central	2⅜
Cactus	10
Calaveras	2½
Chief Cons	1⅜
Corbin	1
Cortez	.45
Crown Reserve	3⅞
Eagle & Blue Bell	1
First Nat. Cop.	2⅛
Majestic	41
Mexican Metals	1½
Moneta Porc.	‡ .06
Nevada-Douglas	1⅜
New Baltic	1
Oneco	1½
Raven Copper	.15
Rhode Island Coal	.07
Smokey Dev.	1⅞
S. W. Miami	3
South Lake	6⅜
Trethewey	.37
United Verde Ext.	.65

‡Last quotation.